FIFTY-NINTH ANNUAL REPORT

TO THE International Joint Commission

COVERING Calendar Year 2017

International Souris River Board

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INTERNATIONAL SOURIS
RIVER BOARD

CONSEIL INTERNATIONALE
DE LA RIVIERE SOURIS

October 2018

The International Joint Commission
Ottawa, Ontario and Washington, D.C.

Commissioners:

In accordance with the Directive of January 22, 2007 (replaces Directives of April 11, 2002 and May 31, 1959), we have enclosed the Fifty-Ninth Annual Report covering calendar year 2017.

Respectively submitted,

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HIGHLIGHTS 2017

For the 2017 calendar year, the natural flow of the Souris River at the Sherwood Crossing was 196,665 cubic decametres (159,501 acre-feet), which represents 123 percent of the 1959-2017 long-term mean. North Dakota received 135,571 cubic decametres (109,952 acre-feet) or 68 percent of the natural flow.

Net depletions in Canada were 61,094 cubic decametres (49,549 acre-feet). Recorded runoff for the Souris River near Sherwood, North Dakota, was 133,576 cubic decametres (108,334 acre-feet), or about 98 percent of the 1931-2017 long-term mean.

The apportionment between Canada and the United States was discussed at the February 23, 2017 meeting of the International Souris River Board. The Board reviewed the spring 2017 runoff forecast hydrologic conditions and declared 2017 to be a flood year.

The natural flow at Sherwood exceeded 50,000 cubic decametres (40,535 acre-feet), resulting in a 60/40 sharing of the natural flow at the Sherwood Crossing.

The flow of the Souris River as it enters North Dakota at Sherwood was more than 0.113 cubic metres per second (cms) (4 cubic feet per second [cfs]) for the entire year. Accordingly, Saskatchewan complied with the 0.113 cms (4 cfs) provision specified in Recommendation No. 1 of the Interim Measures.

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 26,681 cubic decametres (21,639 acre-feet), or 86 percent of the long-term mean since 1959. Recommendation No. 2 of the Interim Measures was met with a net gain in the North Dakota portion of the Long Creek basin of 20,436 cubic decametres (16,574 acre-feet).

Recorded runoff leaving the United States at Westhope during the period of June 1 through October 31, 2017, was 22,054 cubic decametres (17,877 acre-feet). The flow was not in compliance with the 0.566 cms (20 cfs) minimum flow requirement for the June 01 to October 31 period as specified in Recommendation No. 3(a) of the Interim Measures. The period of noncompliance was October 12 to 19, 24, 26, 27, 30 and 31. The noncompliance was due to extreme wind fetch combined with minimal flows.

The water quality of the Souris River in calendar year 2017 has had median values approximately the same or less than the median values over the past four years for most of the parameters. When compared to the historical median, most of the median values in 2017 are similar.

Low dissolved oxygen levels, of great concern in the past, were at or above the water quality objective of 5.0 milligrams per litre at both boundary stations, except for two low values at Westhope in January and February under cover of ice.

The exceedances that occurred at both sites were for parameters that historically have had exceedances of the water quality objectives.

Exceedances of specific water quality objectives at the Saskatchewan/North Dakota boundary include iron, sodium, sulfate, total dissolved solids, phosphorus and total suspended solids.

Exceedances at the North Dakota/Manitoba boundary include phosphorus, sodium, sulfate, dissolved oxygen, pH, total suspended solids, total dissolved solids, fecal coliforms, iron, *E. coli* and Picloram.

In 2017, the International Joint Commission appointed David Pattyson, Debbie McMechan, Joe Goodwill, Shelly Weppler, Lorinda Haman and David O'Connell to the International Souris River Board.

The Government of Saskatchewan renamed Alameda Dam and Reservoir to Grant Devine Dam and Lake.

1.0 INTERNATIONAL SOURIS RIVER BOARD

1.1 SOURIS RIVER REFERENCE (1940)

The following excerpt describes the history of the water-apportionment program that the International Souris River Board currently maintains.

In a letter on behalf of the Government of Canada dated 20 March 1959 and a letter on behalf of the Government of the United States of America dated 3 April 1959, the International Joint Commission was informed that the Interim Measures recommended in its report of 19 March 1958, in substitution for those recommended in the report dated 2 October 1940 in response to the Souris River Reference (1940), had been accepted by both Governments.

The Governments of the United States and Canada entered into an Agreement for Water Supply and Flood Control in the Souris River Basin on October 26, 1989. Pursuant to this Agreement, the Interim Measures related to the sharing of the annual flow of the Souris River from Saskatchewan into North Dakota contained in paragraph 22(1) of the Commission's 1958 Report to the Governments were modified. In light of the modifications in 1989 and pursuant to a February 28, 1992, request from the Governments of the United States and Canada, the Commission, on April 23, 1992, directed the International Souris River Board of Control to begin applying the "Interim Measures as Modified in 1992." The measures were further modified by the Governments in December 2000. The "Interim Measures as Modified in 2000" are shown in Appendix C of this report.

1.2 INTERIM MEASURES AS MODIFIED IN 2000

In December 2000, the International Joint Commission directed the Board to implement the "Interim Measures as Modified in 2000" for the 2001 calendar year and each year thereafter. The 2000 Interim Measures, shown in Appendix C, were developed to provide greater clarification of the conditions that must prevail for the determination of the sharing of natural flow between Saskatchewan and North Dakota at the Sherwood Crossing.

In general, the Interim Measures provide that Saskatchewan shall have the right to divert, store, and use waters that originate in the Saskatchewan portion of the Souris River basin, provided that the annual runoff of the river into North Dakota is not thereby reduced to less than half of the runoff that would have occurred in a state of nature; that North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the basin together with the waters that cross the boundary from Saskatchewan; and that Manitoba shall have the right to use the waters that originate in the Manitoba portion of the basin and, in addition, that North Dakota must provide to Manitoba, except during periods of severe drought, a regulated flow of at least 0.566 cms (20 cfs) during the months of June through October.

For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall as far as practicable regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cms (4 cfs) when that level of flow would have occurred under the conditions of water-use development prevailing in the Saskatchewan portion of the drainage basin prior to the construction of Boundary Dam, Rafferty Dam, and Grant Devine Dam.

Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Grant Devine Reservoirs. During years when those conditions occur, the minimum flow actually passed to North Dakota will be 40 percent of the natural flow at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Grant Devine Dam for flood control.

Except in flood years, flow releases to the United States should occur in the pattern that would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the International Souris River Board that the release would not be of benefit to the State at that time.

The State of North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing, provided that any diversion, use, or storage of Long Creek water shall not diminish the annual runoff at the Eastern Crossing of Long Creek into Saskatchewan below the annual runoff of Long Creek at the Western Crossing into North Dakota.

In periods of severe drought, when it becomes impracticable for North Dakota to deliver the regulated flow of 0.566 cms (20 cfs), North Dakota's responsibility to Manitoba will be limited to providing such flows as the Board determines to be practicable and in accordance with the objective of making water available for human and livestock consumption as well as for household use.

1.3 BOARD OF CONTROL

In May 1959, the International Joint Commission officially approved and signed a directive that created the International Souris River Board of Control. The directive charged the Board with the responsibility of ensuring compliance with the Interim Measures as set out in 1958 and of submitting such reports as the Commission may require or as the Board at its discretion may desire to file.

1.4 AMALGAMATION OF THE INTERNATIONAL SOURIS-RED RIVERS ENGINEERING BOARD AND INTERNATIONAL SOURIS RIVER BOARD OF CONTROL

In 2000, the International Joint Commission directed the International Souris-Red Rivers Engineering Board to transfer its responsibilities that related to the Souris River to the International Souris River Board of Control. The Commission also changed the International Souris River Board of Control's name to the International Souris River Board.

1.5 AMALGAMATION OF THE INTERNATIONAL SOURIS RIVER BOARD AND SOURIS RIVER BI-LATERAL WATER QUALITY MONITORING GROUP

By letter dated January 22, 2007, the International Souris River Board was officially notified by the Commission that the new directive dated January 18, 2007, replaced the previous directive dated April 11, 2002. The new directive sets out the duties of the Board as it moves toward a watershed approach in the Souris River basin and combined the duties of the International Souris River Board and Souris River Bi-Lateral Water Quality Monitoring Group. It also increased the membership of the Board to twelve members.

The Board's duties were revised to include the following:

- Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.

- Oversee the implementation of compliance with the Interim Measures as Modified for Apportionment of the Souris River as described in Appendix A of the Directive.

- Assist the Commission in the review of a Joint Water Quality Monitoring Program.

- Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.

- Report on aquatic ecosystem health issues in the watershed and regularly inform the Commission on the state and implications of aquatic ecosystem health.

- Carry out such other studies or activities as the Commission may, from time to time, request.

- Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year.

- The Board shall submit an annual report covering all of its activities at least three weeks in advance of the Commission's fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive.

- The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year. The Board has agreed to hold the public meeting in the spring/summer and to advertise it.

In 2007 three committees were established to assist the Board administer the requirements of its enhanced mandate. The Natural Flow Methods Committee was renamed as the Hydrology Committee and is charged with investigating procedures and questions on the approach and methods used to determine the natural flow of the Souris River basin. The Flow Forecasting Liaison Committee has the responsibility to ensure information sharing and coordination between the forecasting agencies in the basin. The Aquatic Ecosystem Health Committee has the responsibility to identify water quality and aquatic health concerns in the basin and to report on the adequacy of the aquatic quality monitoring programs. Membership on these committees includes all affected agencies in the basin.

1.6 BOARD MEMBERS

At the end of 2017, the members of the International Souris River Board were as follows:

Russell Boals Retired Regina, Saskatchewan	Member for Canada (Co-Chair to October 31)
Nicole Armstrong Manitoba Sustainable Development Winnipeg, Manitoba	Member for Canada (Co-Chair as of November 1)
John Fahlman Saskatchewan Water Security Agency Moose Jaw, Saskatchewan	Member for Canada
Mark Lee Manitoba Sustainable Development Regina, Saskatchewan	Member for Canada
John-Mark Davies Saskatchewan Water Security Agency Saskatoon, Saskatchewan	Member for Canada
Jeff Woodward Environment and Climate Change Canada Regina, Saskatchewan	Member for Canada
David Pattyson Agri-Environmental Group Plans Tribune, Saskatchewan	Member for Canada
Debbie McMechan Reeve of Two Borders Two Borders, Manitoba	Member for Canada
Joe Goodwill Deputy-Mayor of Souris Souris, Manitoba	Member for Canada
Garland Erbele North Dakota State Engineer Bismarck, North Dakota	Member for the United States (Co-Chair)
Frank Durbian U.S. Fish and Wildlife Service Towner, North Dakota	Member for the United States
Colonel Samuel Calkins U.S. Army Corps of Engineers St. Paul, Minnesota	Member for the United States

Gregg Wiche — Member for the United States
Retired
Bismarck, North Dakota

Scott Gangl — Member for the United States
North Dakota Game and Fish Department
Bismarck, North Dakota

Dave Glatt — Member for the United States
North Dakota Department of Health
Bismarck, North Dakota

Shelly Weppler — Member for the United States
Ward County Commissioner
Minot, North Dakota

Lorinda Haman — Member for the United States
North McHenry Soil Conservation District
Towner, North Dakota

David O'Connell — Member for the United States
Retired
Lansford, North Dakota

Secretaries

Girma Sahlu — Canada
Environment and Climate Change Canada
Winnipeg, Manitoba

Darin Schepp — United States
North Dakota State Water Commission
Bismarck, North Dakota

2.0 2017 ACTIVITIES OF THE BOARD

Since the presentation of the Fifty - Eighth Annual Report to the International Joint Commission, the International Souris River Board has held two face to face meetings, one public meeting and three conference calls. The discussions and decisions made are summarized in the following sections.

2.1 FEBRUARY 23, 2017, MEETING IN REGINA, SASKATCHEWAN

Board Members in attendance were:

Russell Boals, Garland Erbele, John-Mark Davies, Frank Durbian, Nicole Armstrong, Gregg Wiche, Jeff Woodward, David Pattyson, Joe Goodwill, Lorinda Haman, David O'Connell, Shelly Weppler, Mark Lee, David Glatt, Debbie McMechan

The Determination of Natural Flow of the Souris River at Sherwood for the period of January 1 through December 31, 2016, was presented at the February 23, 2017 meeting.

Environment and Climate Change Canada reported the 2016 natural flow for the period ending December 31, 2016. The total diversion in the Souris Rivers basin was 6,634 cubic decametres (5,380 acre-feet). Recorded flow at Sherwood was 41,291 cubic decametres (33,488 acre-feet). The natural flow computed at Sherwood was 47,925 cubic decametres (38,869 acre-feet). According to these computations, the United States share at 50 percent was 23,960 cubic decametres (19,432 acre-feet). The flow received by the United States was 43,119 cubic decametres (34,970 acre-feet) which constitutes a surplus delivery of 19,159 cubic decametres (15,539 acre-feet). The annual flow requirement / apportionment at Long Creek station was met with a surplus of 5,288 cubic decametres (4,289 acre-feet).

The United States Geological Survey (USGS) reported the total volume of flow past the Long Creek at the Noonan gage through December 31, 2016 calendar year was 5,132 acre-feet (6,330 cubic decametres). This volume was about 33 percent greater than the median flow for the last 57 years. Flows were in the normal to above normal range. The peak discharge for the reporting period January 1 to December 31, 2016 is 384 cfs (10.8 cms), which ranks 36 in 57 years of record.

The total volume of flow past the Souris River near Sherwood gage through December 31, 2016 calendar year was 33,476 acre-feet (41,293 cubic decametres). Flows in 2016, based on the last 86 years of data were in the normal to above normal range. The peak discharge for the period January 1 to December 31 was about 260 cfs (7.4 cms).

The total volume of flow recorded at the Souris River near the Westhope gage, through December 31, 2016 calendar year was 92,235 acre-feet (113,772 cubic decametres). The 2016 total flow was about 77 percent of the median flow for the last 87 years. Flows for 2016, based on the last 87 years of record were in the below normal to much above normal range. The peak discharge for the period January 1 to December 31, 2016 was 396 cfs (11.2 cms), which ranks 64th in 87 years of record. There was no joint sampling between Canada and the United States in 2016. The basin was in transition from a dry to a wet period with above normal precipitation expected in the spring. There was an elevated risk for minor flooding in the United States portion of the basin in 2016.

Total yearly provisional flow at Sherwood was 33,476 acre-feet (41,293 cubic decametres) in 2016. This was 28 percent of the historic average annual inflow (based on calendar year), which is 118,260 acre-feet (145,874 cubic decametres) for the period of record from 1938-2016. Total yearly provisional

outflow measured at the Souris River near Foxholm on the south end of the Refuge was 19,255 acre-feet (23,751 cubic decametres) for the period 1938-2016. This was 16 percent of the historic average annual outflow, which is 120,944 acre-feet (149,184 cubic decametres) for the period of 1938-2016. Total inflow was 14,178 acre-feet (17,489 cubic decametres) more than the total measured outflow. On December 31, 2016, Lake Darling was at an elevation of 1596.24 ft (486.53 m).

Total outflow measured at Westhope for 2016 was 92,237 acre-feet (113,774 cubic decametres). Total outflow was 34,022 acre-feet (41,966 cubic decametres) more than inflow on the Souris River at Bantry. Outflow during the June 1 to October 31 period was 38,255 acre-feet (47,188 cubic decametres) or 32,186 acre-feet (39,701 cubic decametres) above the 6,069 acre-feet (7,486 cubic decametres) required minimum. The flow at the Westhope gage fell below the minimum 20 cfs (0.57 cms) threshold during the June 1 to October 31 period, due to a combination of relatively low flows and wind fetch. Three of the days recorded an average daily flow of 13 cfs (0.3 cms) (October 18, 20, and 23). There was one occurrence of 17 cfs (0.48 cms) (October 11th); and one occurrence of an average daily flow of 19 cfs (0.54 cms) (October 22nd).

The Saskatchewan Water Security Agency (WSA) reported that on October 19, 2016, Alameda Reservoir was 0.69 m above its Normal Drawdown Level (NDL) and initiated winter drawdown at a rate of 1.3 cms (46 cfs) to bring the level down to its February 1st NDL. The target drawdown level was achieved on January 18, 2017, 13 days earlier than required, but the outflows were maintained based on conditions in the basin. No drawdown was required at Rafferty Reservoir as the reservoir was 0.43 m (1.4 ft) below its NDL at freeze-up.

Precipitation along the eastern portion of the basin was well above normal during the summer of 2016 (575 mm or 23 in). During the period September 23 to November 21, 2016, precipitation was 160-280 percent of normal. Fall 2016 moisture conditions were wetter than normal at freeze-up, particularly on the eastern side. Estevan had the snowiest December in 100 years, in which 52 cm (20.5 in) of snow fell in December, shattering the historical record. The National Weather Service (NWS) Airborne Gamma Snow Survey for February 2017 showed 45-130 mm (1.8-5.2 in) of Snow-Water Equivalent (SWE) in the basin. A snow survey conducted by the WSA from January 18-19 showed SWE to be near normal in headwater areas to above normal near Alameda Reservoir.

Manitoba reported that fall 2016 soil moisture was normal to well above normal across the Manitoba portion of the basin. The Manitoba portion of the basin has received a mix of below normal, normal, to above normal snow cover in winter 2016/2017. Souris River flows fluctuated throughout the fall and winter as a result of reservoir operation in North Dakota. After repairs to Dam 357 by the United States Fish and Wildlife Service (USFWS), flows in Manitoba were increased over the winter and were well above normal in February 2017.

On January 30, 2017, the Manitoba Hydrologic Forecasting and Coordination Branch released an updated conditions report for spring 2017. The report noted that snow accumulations and soil moisture within the Souris River basin were normal to above normal. Therefore, the runoff potential was well above normal for spring 2017.

The flood risk for the main stem of the Souris River was:

- With favorable weather conditions, there is a moderate risk of flooding,
- With normal weather conditions, there is a major risk downstream of Minot, ND along the mainstem of the Souris River, and
- With unfavorable weather conditions, there is a major to severe flood risk downstream of Minot, ND along the mainstem of the Souris River.

The NWS's probabilistic forecast at the North Dakota-Manitoba border (Westhope, ND) showed that the probability of spring flooding in 2017 was higher than the historical average. With wet conditions in the fall of 2016 and abundant snow fall, there were no drought or water supply concerns in the basin.

The WSA spring runoff forecast as of February 15, 2017, suggested above normal runoff throughout the basin.

There was consensus that there is a flood risk in North Dakota and Manitoba in the spring of 2017. Based on the forecast at Sherwood Crossing, more than 50,000 cubic decametres (40,552 acre-feet), the Board approved the 60/40 split of the natural flow between Canada and the United States, according to Annex B of the 1989 International Agreement.

As a result of the potential of flood conditions in the basin, the Board declared flood operations for the spring of 2017. The United States Army Corps of Engineers was in charge of flood operations in the United States.

The Flow Forecasting Liaison Committee (FFLC) reported that they had completed a Communications Plan, which was approved by the Board. There were two forecasts issued in 2017.

The NWS provided an update on the Winter/Spring outlook for the United States portion of the Souris River Basin. The fall of 2016 was warm and dry with the exception of snowstorm near the end of November. December was brutally cold with a snowstorm over the Christmas period. Temperatures returned to near normal in January with slightly below normal snow. February started cold, but warmed up with fairly dry conditions.

The Aquatic Health Ecosystem Committee reported that Total Phosphorus was the lowest observed in many years. Iron levels are down; the maximum values dropped almost by half, however, Total Iron concentrations at Westhope had increased with numbers similar to those of Sherwood. Sodium concentrations at Sherwood are similar to previous years, but have increased slightly at Westhope. Dissolved Oxygen concentrations at both sites were mostly above the Water Quality Objectives (WQO). Westhope had one sample in January below the objective, but overall the concentrations at Westhope were lower than previous years while the ones at Sherwood remained about the same. Total dissolved solids and pH had a few exceedances but were similar to previous years. All other parameters met the WQOs. Pesticide data were not available at the Westhope site.

With respect to the *E. coli* objective, Westhope had one sample, in late October, above the proposed 400 CFU maximum. Sherwood had no densities above the 400 CFU maximum, but all four samples were in the 100's, which would have placed the seasonal geomean well above the 129 CFU proposed objective.

The USFWS and North Dakota Department of Health conducted a project in 2016 to collect data on water pollutants including cyanotoxins / cyanobacteria. It was noted that the general public was interested in blue-green algae. There was discussion about aquatic invasive species.

The Core Committee met in April 2016 and reviewed the 1989 Agreement line-by-line. No major changes were made to the language. However, some tables needed updating.

It was suggested to establish a committee to address issues related to communication and outreach. The suggested role of the committee was:

- Updating the International Joint Commission (IJC) webpage with information written in plain language on the view and understanding of technical issues,
- Increase awareness in the basin for the general public,
- Fact sheets – update those that are old,
- Improvements to the Annual Report- make it readable by the public,
- Organizing the Public Meetings with greater watershed groups participation, improve our communication with the public.

A working group was set up to draft the draft Terms of Reference of the Committee, with the guidance of the IJC.

The USGS presented the Souris River Story Map, an interactive online webpage hosted on the IJC's ArcGIS. The work was done in cooperation with the North Dakota State Water Commission and collaboration with the IJC.

The Assiniboine River Basin Initiative (ARBI) reported on their current activities and mission. They noted, through consultation with basin stakeholders, that agricultural drainage in the basin was an area of interest. The ARBI also reported on the HydroGeoSphere (HGS) project led by the Manitoba Forage and Grassland Association with funding support from Agriculture and Agri-Food Canada.

The Upper Souris Watershed Association, reported on their "Wetland Restoration Program" that was active over the past four years. The Association was able to restore over 185 acres of wetlands.

The Souris River Joint Board, briefed the Board on the flood protection construction that was underway in the City of Minot.

The Mouse River Association provided an update on activities along the border of the two countries in the Turtle Mountains area and the works done by conservation groups.

2.2 MARCH 21, 2017 CONFERENCE CALL

Board members in attendance were:

Russell Boals, Garland Erbele, Lorinda Haman, Frank Durbian, Shelly Weppler, Gregg Wiche, Jeff Woodward, Joe Goodwill, David O'Connell, Mark Lee, John Fahlman

The Flow Forecasting Liaison Committee reported, as a result of the March 15th forecast, the runoff would be near median conditions above Estevan and below median conditions below Estevan. Average runoff above the reservoirs and above average runoff close to the United States border was expected. The March snowfall in Saskatchewan returned the forecast back to the February estimates. Based on the forecast the maximum target flow for Sherwood was 47 cms (1,660 cfs). According to the 1989 Agreement, Boundary Reservoir elevation should not be higher than 557.8 m (1830.05 ft).

Rafferty reservoir's pre-runoff elevation was 25 cm (9.8 in) below the target elevation of 549.34 m (1802.3 ft), therefore no further releases were needed.

Alameda reservoir's elevation was 2 m (6.6 ft) higher than 557.99 m (1830.7 ft), requiring the reservoir to be drawn down.

During early March there was substantial inflows into Boundary Reservoir and water was diverted to Rafferty reservoir.

The United States Geological Survey, and United States Army Corps of Engineers presented an overview of runoff conditions in North Dakota. Based on the March 15th forecast, a drawdown of Lake Darling to 1593.5 ft (485.7 m) was initiated. The target flow, based on the 1989 Agreement, was 2,000 cfs (57 cms) at Minot.

There was some forecasted uncertainty with respect to the hydrologic response of the Des Lacs Wildlife Refuge.

Manitoba reported that the Souris River was flowing out of its banks in the Melita area. However, Manitoba was unsure if the water was coming from the upstream refuge or some other source.

The Water Security Agency's operating plan was to divert all inflow above Full Supply Level from Boundary reservoir into Rafferty reservoir, as Rafferty was not expected to fill, and to manage the Alameda outflow to reach the target elevation in conjunction with minimizing downstream impacts. The operating plan for Lake Darling was to draw the lake down to 1593.5 ft (485.7 m) with a target flow 2,000 cfs (57 cms) at Minot, ND. The United States Fish and Wildlife Service proposed to operate Lake Darling at an elevation of 1596 ft (486.5 m) instead of 1597 ft (486.7 m) as of June 1st to provide storage for summer rains to minimize downstream flooding potential.

2.3 APRIL 5, 2017 CONFERENCE CALL

Board Members in attendance were:

Garland Erbele, Scott Gangl, John-Mark Davies, Lorinda Haman, Frank Durbian, Shelly Weppler, Jeff Woodward, Joe Goodwill, Mark Lee, John Fahlman, David Pattyson

The Water Security Agency reported that:

- Boundary reservoir was essentially full (10 cm [4 in] below Full Supply Level [FSL]). Flow was being diverted from Boundary into Rafferty reservoir at 4 cms (141 cfs).

- Rafferty reservoir was at an elevation of 550.36 m (1805.6 ft) (15 cm [6 in] below FSL) and would fill within the next week.

- Alameda reservoir was at an elevation of 551.9 m (1810.7 ft) (0.7 m [2 ft] below FSL) and inflows into the reservoir were dropping off.

In general, the flow above the reservoirs were in recession and could be passed downstream without causing problems.

The United States Army Corps of Engineers provided an update on Lake Darling. Lake Darling is 1.3 ft (40 cm) below its FSL. The plan was to hold the lake a foot lower. The inflow of 1,700 cfs (48 cms) was receding, the discharge from Lake Darling was 1,200 cfs (34 cms), which would be reduced to 800 cfs (23 cms). The outflow would be further reduced as inflows recede to reach the target elevation.

The lower Souris River near Towner, ND and Westhope, ND was experiencing significant lowland flooding with roads and culverts being washed out.

Manitoba provided an update on their flooding situation and confirmed that there was overland flooding, road washouts and ice jamming. The rural municipality of Two Borders was impacted by the overland flooding and had declared a state of emergency on March 31st.

The Water Survey of Canada gauging station at Wawanesa records were indicating a flow of 500 cms (17,600 cfs) or a 1:20 to 1:50 year flood event. The river reached an elevation within 3-4 ft of 2011 flood levels.

2.4 APRIL 19, 2017 CONFERENCE CALL

Board Members in attendance were:

Russell Boals, Garland Erbele, Frank Durbian, Gregg Wiche, Jeff Woodward, Joe Goodwill, David O'Connell, Frank Durbian, John Fahlman, David Pattyson, Scott Gangl

Saskatchewan reported that:

- Rafferty Reservoir was at 550.0 m (1804.5 ft) (Full Supply Level [FSL]) and receiving 2 cms (71 cfs) from Boundary reservoir, while releasing 5 cms (177 cfs) downstream.
- Alameda reservoir was 11 cm (4 in) below its FSL, releasing 5 cms (177 cfs) downstream.
- Boundary reservoir was about 5 cm (2 in) below its FSL with 2 cms (71 cfs) diverted into Rafferty.

The Water Security Agency reported that the reservoir system worked well and that they were able to store all inflows for three weeks until downstream runoff started.

The United States Fish and Wildlife Service reported that flows are moving slowly through the system and that the outflows from Lake Darling were 800 cfs (164 cms) and flows at Minot, ND, were at 1,040 cfs (29 cms). The J. Clark Salyer National Wildlife Refuge (Lower Souris) area had experienced some road and culvert washout with some still under water.

Manitoba reported that the river had come to within 3-4 ft of the 2011 flood levels. While there was some overland flooding, the dike system through the populated areas worked well.

The Board has agreed that there was no need for another conference call unless there are major changes in precipitation conditions and that the Board would declare flood operations to be over via an exchange of email when the Souris River flow recedes to 500 cfs (14 cms) at Minot, ND.

2.5 JUNE 27, 2017 MEETING IN BOISSEVAIN, MANITOBA

Board Members in attendance were:

Russell Boals, Garland Erbele, Frank Durbian, Nicole Armstrong, Mark Lee, Joe Goodwill, Scott Gangl, Dave Pattyson, Gregg Wiche, Debbie McMechan, Lorinda Haman, Shelly Weppler, David O'Connell, Jeff Woodward, John-Mark Davies, Mark Gabriel, David Glatt

The Public Meeting, which was held the night prior, was informative and all enjoyed the presentations. The information presented on water quality was useful and the public had opportunity to present their concerns and engage the Board in discussions. Board agencies had an opportunity to explain to the general public how water control structures, such as dams, are operated during flood and non-flood operations. The International Joint Commission (IJC) representatives noted that the public involvement was good and commended the openness and inclusiveness of the Board.

Environment and Climate Change Canada (ECCC) reported the results of the natural flow determined for the period ending May 31, 2017. The total diversion in the Souris River basin was 103,798 cubic decametres (81,183 acre-feet). Recorded flow at Sherwood was 108,990 cubic decametres (88,394 acre-feet). The natural flow computed at Sherwood was 193,317 cubic decametres (156,786 acre-feet). The United States share at 40 percent was 77,330 cubic decametres (62,717 acre-feet). The flow received by the United States was 110,982 cubic decametres (90,010 acre-feet), which constituted a surplus delivery of 33,652 cubic decametres (27,293 acre-feet).

The annual flow requirement / apportionment at Long Creek was also met with an increase of 18,450 cubic decametres (14,964 acre-feet) between Western Crossing and Noonan.

It was confirmed that the apportionment for 2017 would be a 60/40 split between Canada and the United States.

The Hydrology Committee reported that the draft Procedures Manual was nearing completion. There were no major changes to the hydrometric gaging station networks in Canada and the United States.

The Water Security Agency (WSA) reported that 2016 fall moisture conditions in the basin were wetter than normal at freeze-up, particularly on the eastern side. Estevan, SK had the snowiest December in 100 years. According to the National Weather Service (NWS) Airborne Gamma snow survey for March 2017, the snowpack was near normal in the headwaters area and well above normal downstream of the reservoirs.

On October 19, 2016, flows were initiated at a rate of 1.3 cms (46 cfs) from Alameda Dam to draw the reservoir down to its February 1st Normal Drawdown Level (NDL) over the winter months. Alameda Reservoir was 0.69 m (2.2 ft) above its NDL as of October 2016. The NDL was achieved on January 18, 2017 (13 days early), but the outflow was maintained in anticipation of the potential for a further drawdown requirement. Rafferty Reservoir was 0.43 m (1.4 ft) below its NDL at freeze-up.

Above normal runoff was expected throughout the basin in 2017. The flood operations were based on Sherwood flows exceeding 37,000 cubic decametres (30,008 acre-feet). No additional drawdown was required at Rafferty reservoir. However, an additional drawdown was required at Alameda reservoir.

The target elevation of 557.87 m (1830.3 ft) was set for Alameda reservoir based on February 1st and 15th inflow forecasts of 36,000 cubic decametres (29,197 acre-feet). There was minimal snowfall in February, which reduced the March 1st Alameda inflow forecast to 19,000 cubic decametres (15,410 acre-feet) and the drawdown target to 560.20 m (1837.9 ft). At that time, the reservoir was 0.26 m or 2,900 cubic decametres (0.85 or 2,352 acre-feet) below the target, and the outflow was terminated. The March snowfall was above normal, which increased the inflow forecast to 35,000 cubic decametres (28,386 acre-feet) and also increased the drawdown target to 557.99 m (1830.7 ft). Outflows were aggressively staged up in an attempt to reach the target prior to the start of runoff.

With runoff underway in areas below the reservoir, the outflow was terminated on March 24th at 1.26 m or 11,260 cubic decametres (4.1 ft or 9,132 acre-feet) above the target. Actual inflow volumes were lower than forecasted, due to an early snowpack limiting frost penetration into the ground, which allowed for additional infiltration during the melt. Had the drawdown objective been achieved, the reservoir would not have filled in 2017 (900 cubic decametres or 0.08 m [730 acre-feet or 0.3 ft]).

Overall, the system worked well during the 2017 snowmelt runoff. Inflows arriving at the Saskatchewan reservoirs were stored for the first 24 days of the snowmelt event. This reduced the peak at the Sherwood Crossing from an estimated unregulated peak of 150 cms (5,297 cfs) to just 10 cms (353 cfs). All of the Saskatchewan reservoirs were near full supply level at the end of the spring event.

The WSA planed on maintaining a 0.5 cms (17 cfs) outflow from Rafferty reservoir throughout the summer for water quality and ecological benefits. No release was planned from Alameda reservoir during the summer of 2017. Initiation of an outflow at Alameda and adjustment of the outflow at Rafferty would take place in October to achieve NDL by February 1, 2018. Release rates would depend on summer inflows to the reservoirs and net evaporation.

There were near record dry conditions in the basin following the spring runoff with 20-80 percent of normal precipitation between April 1 and May 31, 2017. A rain event was observed on June 14th near Corning, SK with 87 mm (3.4 in) of rain in the area. The 12-hour total of 81 mm (3.2 in) was about 1:100-year event. Higher accumulations were localized, but 40-55 mm (1.6-2.2 in) was observed over most of the Moose Mountain Creek basin. The event generated a runoff response below Moose Mountain reservoir, which resulted in a 15 cms (530 cfs) release from Alameda on June 15th, which was reduced to 10 cms (353 cfs) on June 16th.

The United States Geological Survey (USGS) reported the total volume of flow past the Long Creek near Noonan gage through May 31, 2017 calendar year was 38,260 acre-feet (47,194 cubic decametres). This volume was about 235 percent of the median flow for the past 57 years. Flows for the current year were in the normal to much above normal range. Peak discharge for the reporting period January 1 to May 31, 2017 was 2,160 cfs (61.3 cms), which ranks 15th in 57 years of record.

The total volume of flow past the Souris River near Sherwood gage through May 31, 2017 calendar year was 88,500 acre-feet (109,165 cubic decametres). This volume was about 163 percent of the median flow for the past 86 years. Flows for the current year, based on the last 86 years of record were in the normal to above normal range. The peak discharge for the period January 1 to May 31 was about 1,800 cfs (51.10 cms) on April 1st, which ranks 27th in 86 years of record.

The total volume of flow past the Souris River near Westhope gage, through May 31, 2017, was about 548,540 acre-feet (676,624 cubic decametres). This calendar year's total flow to May 31st was about 456 percent of the median flow for the past 86 years. Flows for the current year, based on the last 87 years of record were in the normal to much above normal range. The peak discharge for the period January 1 to May 31 was 8,360 cfs (237.3 cms) on April 7th, which ranks 3rd in 87 years of record. Based on unregulated flow analysis, this year's peak was between a 10-year to 25-year recurrence.

The USGS reported that their Cooperative Water Quality Sampling Network on the Souris River consisted of eleven gaging stations, which are sampled on a regular basis. Of these eleven gaging stations, three are sampled eight times a year, three are sampled six times a year, four are sampled four times a year and one site is sampled once a year in a Quality Assurance/Quality Control sampling program with ECCC. The sampling frequency, constituent groups and sampling objectives were developed by the USGS and ECCC. The sampling frequency and timing were implemented in 2012 and were determined from an analysis of network efficiency completed in 2012. The report is available at the following website link: https://pubs.er.usgs.gov/publication/sir20125216

The USGS presented a table that depicted the spring 2017 Hydrologic Summary prepared by the USGS and the National Weather Service (NWS). The table showed precipitation values and their respective deficits for a number of long-term sites in North Dakota. The results showed a very dry period for May and early June 2017. Bismarck, not in the Souris Basin, and Minot had recorded their fourth and tenth driest month of May on record with 143 and 111 years of data, respectively.

Manitoba reported fall soil moisture was normal to well above normal in the Manitoba portion of the basin. Over the 2016-2017 winter, they received a mix of below normal, normal, and above normal snow cover. The runoff potential was well above normal for the 2017 spring.

The spring melt began in late March with Manitoba tributaries and mainstem seeing rapid rises and as expected, the melt produced very high runoff. The tributaries peaked in early April. The return period of these flows was in the 20-year to over 50-year event range. The Souris River peaked at Wawanesa at approximately 525 cms (18,500 cfs) on April 5th. This corresponded to approximately a 1-in-40-year event. Only the floods of 1882, 1904, 1976, and 2011 exceeded the peak flow of 2017. Much of the flow contributing to the peak was from local Manitoba runoff with flow from North Dakota filling in the recession limb of the hydrograph.

After the spring freshet, flows declined on the mainstem. The late June flow at Wawanesa was 12.2 cms (430 cfs), which was near the median for this time of year. Precipitation was mixed in the area. Areas that have received precipitation remain wet, whereas other areas that have experienced dry conditions were drier than normal. Manitoba Agriculture reported that crops in northern areas were in great shape, but some fields in the southwest corner were experiencing moderate moisture stress with standing water in low lying areas. Most crops were benefitting from recent rains. Overall, there were no significant water supply or drought concerns at this time.

The United States Fish and Wildlife Service presented a summary of refuge operations in North Dakota. The total provisional inflow measured at Sherwood for the first five months of the year was 88,509 acre-feet (109,176 cubic decametres). This was 106 percent of the historic January-May inflow, which was 83,462 acre-feet (102,950 cubic decametres) for the period 1938 through 2017.

The Upper Souris Refuge pool volume decreased an estimated 377 acre-feet (465 cubic decametres) during the first five months of the year. The total provisional outflow measured at Foxholm on the south end of the Upper Souris Refuge for the first five months of 2017 was 108,531 acre-feet (133,873 cubic decametres). The outflow was 152 percent of the historic record for the January-May outflow, which was 71,486 acre-feet (88,178 cubic decametres) for the period 1938 through 2017. Lake Darling elevation decreased 0.12 ft (0.04 m) from 1596.24 ft (486.54 m) on January 1st to 1596.12 ft (486.50 m) on May 31st. The lake elevation on June 1st was 1596.12 ft (486.50 m).

Regarding the J. Clark Salyer National Wildlife Refuge, the total provisional inflow for the period January to May 31, 2017 was 199,099 acre-feet (245,589 cubic decametres). The inflow was 184 percent of the historic record for the same period, which was 108,119 acre-feet (133,365 cubic decametres) for the period of 1938-2017. Total pool volume on May 31st was 28,570 acre-feet (35,241 cubic decametres). This was 3,775 acre-feet (4,656 cubic decametres) below the January 1st volume of 32,345 acre-feet (39,898 cubic decametres).

Approximately 548,545 acre-feet (676,630 cubic decametres) was passed to Manitoba during the five-month period.

The Aquatic Ecosystem Health Committee (AEHC) reported that it had updated the Spill Communication Protocol. The Committee presented a summary of the water quality monitoring program. ECCC collected nine water quality samples from the Souris River in 2016. Eight samples were collected at Westhope (January, February, May, triplicate in June, July, August, September and October). The USGS collected a total of eight water quality samples from the Souris River at the Sherwood site in 2016 (January, two in April, May, June, July and August). One joint sample (USGS and ECCC) was collected at both sites in August 2016.

The highlights for the Sherwood and Westhope sites were:

- Total Phosphorus exceeded its Water Quality Objective (WQO) of 0.10 mg/L in five of eight samples collected at the Sherwood site and all samples collected at the Westhope site in 2016. Values ranged from 0.06 mg/L in April to 0.44 mg/L in October.

- Sodium exceeded its objective of 100 mg/L for six of the eight samples collected at the Sherwood site and all samples collected at the Westhope site. Results ranged from 72 mg/L in January to 236 mg/L in July

- Sulphate exceeded its objective of 450 mg/L one sample collected at the Sherwood site and one sample collected at the Westhope site, with a maximum concentration of 505 mg/L at Sherwood and 451 mg/L at Westhope, both in July.

- Total Dissolved Solids exceeded the WQO of 1000 mg/L once at the Sherwood site in July with a value of 1080 mg/L, twice in January with values of 1139 mg/L and once in June with a value of 1001 mg/L at the Westhope site. The minimum value collected at the Sherwood site was 576 mg/L, in January and 775 mg/L at the Westhope site in July.

- Total iron exceeded its WQO of 300 μg/L six out of eight times at the Sherwood site and seven out of eight times at the Westhope site. The maximum value was 2,860 μg/L in October at the Sherwood site and 3,390 μg/L at the Westhope site also in October.

- pH did not exceed the WQO of 8.5 pH units and 6.5 units at the Sherwood site, but did in five out of eight samples collected at the Westhope site. The maximum value of 8.4 was recorded in both April and October at Sherwood and in August at the Westhope.

- Molybdenum did not exceed the WQO of 10 mg/L for either site in 2016.

- Dissolved Oxygen (DO) concentrations remained at or above the 5 mg/L WQO for all samples at the Sherwood site and all but one sample collected at the Westhope site. The lowest value at Sherwood was 6.5 mg/L occurring in both May and July, and the lowest value at Westhope was 2.63 mg/L in January.

- *E. coli* did not exceed the proposed maximum WQO of 400 colonies /100 ml at the Sherwood site and had one exceedance in October at the Westhope site.

- Fecal coliform - No data was collected at the Sherwood site, it exceeded the WQO of 200 colonies per 100 ml once at the Westhope site on October 26, 2016.

- Chloride did not exceed the WQO of 100 mg/L at either site in 2016.

- Organics – Pesticide samples were collected from April through October, excluding September at the Sherwood site and May to October, excluding August at the Westhope site.

- 2, 4-D, Atrazine, and MCPA were detected, but well below the WQOs at the Sherwood site, Picloram exceeded the guideline of 0.05 μg/L in May, June and July at the Westhope site.

- Total Boron did not exceed its objective of 0.50 mg/L at either site in 2016.

One hundred three different pesticides were sampled; and the guidelines were incorporated into the WQOs. Twenty had detections and could be worth investigating in the future.

Total Phosphorus concentrations have declined at Westhope at the same time, they have increased at Sherwood and could be further investigated. Iron exceedances could be attributed to background soil conditions and high coal deposits in the area/basin. The AEHC planned to continue with the same sampling schedule in 2017.

The 1989 Agreement Core Committee reported that they had met to review and update the Annex. The majority of the work was complete, therefore a draft version would be submitted to the Board.

The North Dakota Department of Health reported on the Aquatic Invasive Species (AIS) project and on the Harmful Algal Blooms (HABs) project. The project focus was on cyanobacteria or blue-green algae in the North Dakota portion of the Souris River basin. The study results helped in deciding when to issue advisories and warnings to the general public.

The Board discussed the IJC's Climate Change Framework. Board members shared their experience regarding climate change and how climate change impacts their respective jurisdictions with respect to floods, droughts, water quality and AIS.

The Board agreed to discuss tile drainage and its implications at a future meeting.

The Board approved the Terms of Reference and established a Communications and Outreach Committee.

The Upper Souris River Watershed reported on issues regarding decommissioning of old wells and restoration of wetlands. They also discussed AIS and how citizens are involved in a monitoring program.

The Souris River Joint Board discussed the Mouse /Souris River Plan in North Dakota and the damages in the City of Minot from the 2011 flood. In 2011, the flood damaged 4,100 homes, 11,000 people were displaced and the damages were in excess of $1 billion.

The Assiniboine River Basin Initiative made a brief presentation about their activities in the Assiniboine River basin. They have completed a Framework Plan, a State of the Basin Report and modeling for flood preparedness. They have also conducted four webinars on tile drainage issues. The webinars are available on ‘YouTube’.

3.0 MONITORING

3.1 INSPECTIONS OF THE BASIN

During 2017, the staff of the Water Survey Division of Environment and Climate Change Canada, Saskatchewan Water Security Agency, the North Dakota State Water Commission, Manitoba Sustainable Development, and the United States Geological Survey carried out frequent field inspections of the Souris River basin.

3.2 GAUGING STATIONS

A list of the gauging stations being operated in the Souris River basin is provided in Table 1. In addition, the United States Geological Survey operated three miscellaneous stream flow-measurement sites in the vicinity of the Eaton Irrigation Project near Towner, North Dakota.

The station numbers and the locations of the hydrometric stations measuring streamflow are shown in Part I of Table 1. The gauging station numbers and the locations of the hydrometric stations located on lakes and reservoirs in the basin are shown in Part II of Table 1.

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part I--Streamflow

Index Number	Stream	Location	State or Province	Operated By
05NA003 (5113360)	Long Creek[1]	at Western Crossing	Saskatchewan	Environment and Climate Change Canada
05NA004	Long Creek	near Maxim	Saskatchewan	Saskatchewan Water Security Agency
05NA005	Gibson Creek	near Radville	Saskatchewan	Environment and Climate Change Canada
05NB001	Long Creek	near Estevan	Saskatchewan	Environment and Climate Change Canada
05NB011	Yellow Grass Ditch	near Yellow Grass	Saskatchewan	Environment and Climate Change Canada
05NB014	Jewel Creek	near Goodwater	Saskatchewan	Environment and Climate Change Canada
05NB018	Tatagwa Lake Drain	near Weyburn	Saskatchewan	Environment and Climate Change Canada
05NB021 (5113800)	Short Creek[1]	near Roche Percee	Saskatchewan	Environment and Climate Change Canada
05NB031	Souris River	near Bechard[2]	Saskatchewan	Saskatchewan Water Security Agency
05NB033	Moseley Creek	near Halbrite	Saskatchewan	Environment and Climate Change Canada
05NB034	Roughbark Creek	near Goodwater	Saskatchewan	Environment and Climate Change Canada
05NB035	Cooke Creek	near Goodwater	Saskatchewan	Environment and Climate Change Canada
05NB036	Souris River	below Rafferty Reservoir	Saskatchewan	Environment and Climate Change Canada
05NB038	Boundary Reservoir Diversion Canal	near Estevan	Saskatchewan	Environment and Climate Change Canada
05NB039	Tributary	near Outram	Saskatchewan	Environment and Climate Change Canada
05NB040	Souris River	near Ralph	Saskatchewan	Environment and Climate Change Canada
05NB041	Roughbark Creek	above Rafferty Reservoir	Saskatchewan	Environment and Climate Change Canada
05NC001	Moose Mountain Creek	below Moose Mountain Lake	Saskatchewan	Saskatchewan Water Security Agency
05ND010	Moose Mountain Creek	above Grant Devine Lake	Saskatchewan	Environment and Climate Change Canada

Index Number	Stream	Location	State or Province	Operated By
05ND011	Shepherd Creek	near Alameda	Saskatchewan	Environment and Climate Change Canada
05ND013	Moose Mountain Creek	below Grant Devine Lake	Saskatchewan	Environment and Climate Change Canada
05NE003	Pipestone Creek	above Moose Mountain Reservoir	Saskatchewan	Environment and Climate Change Canada
05NF001	Souris River	at Melita	Manitoba	Environment and Climate Change Canada
05NF002	Antler River	near Melita	Manitoba	Environment and Climate Change Canada
05NF006	Lightning Creek	near Carnduff	Saskatchewan	Environment and Climate Change Canada
05NF007	Gainsborough Creek	near Lyleton	Manitoba	Environment and Climate Change Canada
05NF008	Graham Creek	near Melita	Manitoba	Environment and Climate Change Canada
05NF010	Antler River	near Wauchope	Saskatchewan	Environment and Climate Change Canada
05NG001	Souris River	at Wawanesa	Manitoba	Environment and Climate Change Canada
05NG003	Pipestone Creek	near Pipestone	Manitoba	Environment and Climate Change Canada
05NG007	Plum Creek	near Souris	Manitoba	Environment and Climate Change Canada
05NG012	Elgin Creek	near Souris	Manitoba	Environment and Climate Change Canada
05NG020	Medora Creek	near Napinka	Manitoba	Environment and Climate Change Canada
05NG021	Souris River	at Souris	Manitoba	Environment and Climate Change Canada
05NG024	Pipestone Creek	near Sask. Boundary	Manitoba	Environment and Climate Change Canada
5113520	Long Creek Tributary	near Crosby	North Dakota	United States Geological Survey
5113600 (05NB027)	Long Creek[1 3]	near Noonan	North Dakota	United States Geological Survey
5114000 (05ND007)	Souris River[1 3]	near Sherwood	North Dakota	United States Geological Survey
5116000	Souris River[3]	near Foxholm	North Dakota	United States Geological Survey
5116135	Tasker Coulee Tributary	near Kenaston	North Dakota	United States Geological Survey
5116500	Des Lacs River[3]	at Foxholm	North Dakota	United States Geological Survey
5117500	Souris River[3]	above Minot	North Dakota	United States Geological Survey
5119410	Bonnes Coulee	near Velva	North Dakota	United States Geological Survey
5120000	Souris River[3]	near Verendrye	North Dakota	United States Geological Survey
5120180	Wintering River Tributary	near Kongsberg	North Dakota	United States Geological Survey
5120500	Wintering River[3]	near Karlsruhe	North Dakota	United States Geological Survey
5122000	Souris River[3]	near Bantry	North Dakota	United States Geological Survey
5123300	Oak Creek Tributary	near Bottineau	North Dakota	United States Geological Survey
5123400	Willow Creek[3]	near Willow City	North Dakota	United States Geological Survey
5123510	Deep River[3]	near Upham	North Dakota	United States Geological Survey
5124000 (05NF012)	Souris River[1 3]	near Westhope	North Dakota	United States Geological Survey

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part II--Water Level

Index Number	Stream	Location	State or Province	Operated By
5113750	East Branch Short Creek Reservoir	near Columbus	North Dakota	United States Geological Survey
5115500	Lake Darling	near Foxholm	North Dakota	United States Geological Survey
LGNN8	Souris River	at Logan	North Dakota	United States Army Corps of Engineers
				United States National Weather Service
SWRN8	Souris River	at Sawyer	North Dakota	United States Army Corps of Engineers
				United States National Weather Service
TOWN8	Souris River	at Towner	North Dakota	United States Army Corps of Engineers
				United States National Weather Service
VLVN8	Souris River	at Velva	North Dakota	United States Army Corps of Engineers United States National Weather Service
	Upper Souris Refuge	Dams 87 and 96	North Dakota	United States Fish and Wildlife Service
	Des Lacs Refuge	Units 1 - 8 inclusive	North Dakota	United States Fish and Wildlife Service
	J. Clark Salyer Refuge	Dams 320, 326, 332, 341, and 357	North Dakota	United States Fish and Wildlife Service
05NA006	Larsen Reservoir	near Radville	Saskatchewan	Environment and Climate Change Canada
05NB012	Boundary Reservoir	near Estevan	Saskatchewan	Saskatchewan Water Security Agency
05NB016	Roughbark Reservoir	near Weyburn	Saskatchewan	Environment and Climate Change Canada
05NB020	Nickle Lake	near Weyburn	Saskatchewan	Environment and Climate Change Canada
05NB032	Rafferty Reservoir	near Estevan	Saskatchewan	Environment and Climate Change Canada
05NC002	Moose Mountain Lake	near Corning	Saskatchewan	Environment and Climate Change Canada
05ND008	White Bear (Carlyle) Lake	near Carlyle	Saskatchewan	Saskatchewan Water Security Agency
05ND009	Kenosee Lake	near Carlyle	Saskatchewan	Saskatchewan Water Security Agency
05ND012	Grant Devine Lake	near Alameda	Saskatchewan	Environment and Climate Change Canada
05NE002	Moosomin Lake	near Moosomin	Saskatchewan	Environment and Climate Change Canada
05NF804	Metigoshe Lake	near Metigoshe	Manitoba	Manitoba Infrastructure
05NF805	Sharpe Lake	near Deloraine	Manitoba	Manitoba Infrastructure
05NG023	Whitewater Lake	near Boissevain	Manitoba	Environment and Climate Change Canada
05NG801	Plum Lake	above Deleau Dam	Manitoba	Manitoba Infrastructure
05NG803	Elgin Reservoir	near Elgin	Manitoba	Manitoba Infrastructure
05NG806	Souris River	above Hartney Dam	Manitoba	Manitoba Infrastructure
05NG807	Souris River	above Napinka Dam	Manitoba	Manitoba Infrastructure
05NG809	Plum Lake	near Findlay	Manitoba	Manitoba Infrastructure
05NG813	Oak Lake	at Oak Lake Resort	Manitoba	Manitoba Infrastructure
05NG814	Deloraine Reservoir	near Deloraine	Manitoba	Manitoba Infrastructure

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part III--Water Quality

Index Number	Stream	Location	State or Province	Operated By
5114000 (05ND007)	Souris River1 [3]	near Sherwood	North Dakota	United States Geological Survey
5115500	Lake Darling	near Foxholm	North Dakota	United States Geological Survey
5116000	Souris River[3]	near Foxholm	North Dakota	United States Geological Survey
5116500 (380021)	Des Lacs River[3]	at Foxholm	North Dakota	United States Geological Survey and North Dakota Department of Health
5117500 (380161)	Souris River[3]	above Minot	North Dakota	United States Geological Survey and North Dakota Department of Health
5120000 (380095)	Souris River[3]	near Verendrye	North Dakota	United States Geological Survey and North Dakota Department of Health
5122000	Souris River[3]	near Bantry	North Dakota	United States Geological Survey
5123400	Willow Creek[3]	near Willow City	North Dakota	United States Geological Survey
5123510	Deep River[3]	near Upham	North Dakota	United States Geological Survey
	J. Clark Salyer Refuge	Pool 357	North Dakota	United States Fish and Wildlife Service
5124000 (05NF012)	Souris River1[3]	near Westhope (QA)	North Dakota	United States Geological Survey Environment and Climate Change Canada
MB05NGS003	Souris River	near Treesbank (PR #530)	Manitoba	Manitoba Sustainable Development
MB05NGS004	Souris River	at Souris (PTH #22)	Manitoba	Manitoba Sustainable Development
MB05NFS024	Souris River	near Melita (PTH #3)	Manitoba	Manitoba Sustainable Development
MB05NGS079	Pipestone Creek	near Kola (PR #257)	Manitoba	Manitoba Sustainable Development
MB05NGS026	Pipestone Creek	at diversion (Mile Rd 150 W)	Manitoba	Manitoba Sustainable Development

[1] International gauging station

[2] Formerly published as Souris River below Lewvan

[3] Operated jointly for hydrometric and water-quality monitoring

4.0 TRANSBOUNDARY WATER QUALITY OBJECTIVES AND MONITORING

The water quality of the Souris River at the International Boundary has been monitored by the International Souris River Board (formally the Souris River Bilateral Water Quality Monitoring Group) since 1990. The two sites are located at the Saskatchewan/North Dakota border near Sherwood, ND, and at the North Dakota/Manitoba border near Westhope, ND.

The Aquatic Ecosystem Health Committee (AEHC) held two conference calls to discuss work plans and to formulate action items for the next year. A committee meeting was held in June to review the activities of the AEHC.

4.1 OVERVIEW OF WATER QUALITY

The water quality of the Souris River at the International Boundary has been monitored by the International Souris River Board (formally the Souris River Bilateral Water Quality Monitoring Group) since 1990. The two monitoring sites are located at the Saskatchewan/North Dakota border near Sherwood, ND, where data is collected by the United States Geological Survey (USGS), and at the North Dakota/Manitoba border near Westhope, ND, where data is collected by Environment and Climate Change Canada (ECCC).

Water Quality Objectives (WQO) are established for the two border crossings. When WQOs are not achieved, such conditions are referred to as “exceedances”. A summary of water quality exceedances for 2017, along with historical data, is reported in Appendix E.

Historically, the principal concerns regarding water quality in the Souris River basin are related to high total dissolved solids (TDS), depleted dissolved oxygen (DO), and high levels of nutrients, especially phosphorus. High TDS increases the hardness of water and can cause scale build up in pipes and filters. High TDS can also negatively impact use of water for irrigation or as a drinking water source. At higher levels, TDS can also affect aquatic life, especially spawning fish and juveniles. Low DO levels, or hypoxia, can result in the death of fish and other aquatic life and mobilize trace metals. High nutrient concentrations including phosphorus can cause algae blooms, which, depending on how the blooms form and ultimately decompose, can lead to reductions in DO. High nutrient concentrations are also associated with the greater prevalence of cyanobacteria (blue-green algae), which under certain conditions can produce toxins that are harmful to humans and animals.

At the Saskatchewan/North Dakota border crossing in Sherwood, the USGS conducted water quality sampling eight times in 2017. At the North Dakota/Manitoba border crossing near Westhope, the USGS collected one sample in 2017 simultaneously with ECCC to compare sampling methods. ECCC conducted water quality sampling eight times in 2017 at the North Dakota/Manitoba border crossing.

A summary of 2017 water quality findings for the Sherwood site, where the Souris River crosses the border from Saskatchewan into North Dakota, is as follows.

Compared to the four years previous to 2017, the median and maximum concentrations declined for some metals (cobalt and iron). Due to the dry conditions, most concentrations were similar to historical averages with a few metals (molybdenum, selenium, boron) showing slight increases. Of all metals, only concentrations of total iron were higher than the WQO. However, median iron concentrations in 2017 were actually lower than the median concentrations in several previous years.

Median chloride concentrations have increased over the last four years but remained below the WQO. The median concentration for sodium decreased from 2016, but the number of exceedances has increased over the past five years. In 2017, 88 percent (seven of eight) of the samples exceeded the objective. Sulfate median concentrations for 2017 exceeded both the historical median and the 2016 median concentrations. The median concentration in 2016 for sulfate was 297 mg/L, while the median concentration in 2017 was 411 mg/L. However, there were still only two concentrations over the objective of 450 mg/L. If low water conditions continue, further attention should be given to this parameter. Median TDS concentrations also increased as compared to the historic median including in 2016. The median concentration increased from 780 mg/L in 2016 to 958 mg/L in 2017, most likely due to the very low precipitation experienced in 2017.

This is the fourth year *E. coli* bacteria samples have been analyzed, and the densities are below the proposed WQO.

While DO has historically been a constituent of concern, this year concentrations remained above the WQO for all samples. DO values ranged from 5.2 milligrams per litre to 11.3 milligrams per litre. A concentration of less than 5.0 milligrams per litre is considered to not meet its objective.

For nutrients like phosphorus and nitrogen, median and maximum concentrations for 2017 are similar to the historic median and maximum concentrations. Total phosphorus concentrations exceeded the WQO 100 percent of the time.

Pesticide samples were also collected as a part of an intensive statewide study conducted by the North Dakota Department of Agriculture. Ninety-eight pesticides were tested and none were above the WQO, or for those not part of routine testing, none were above either aquatic life benchmarks of human health limits. Two pesticides (2,4-D and Atrazine) had positive, though very low concentrations.

For the Westhope site, where the Souris River crosses from North Dakota into Manitoba, exceedances of WQOs for nutrients, major ions and metals included total phosphorus, sodium, sulphate, total dissolved solids and total iron. Total phosphorus did not meet WQOs in any of the eight samples. Sodium exceeded the WQO in seven of the eight samples. Sulphate concentrations can fluctuate from year to year, but the 63 percent exceedance rate seen in 2017 is well above normal. The iron objective was exceeded in six of eight samples in 2017, which is high for this site, as it was for 2016.

Reportable physical parameters include DO, pH, total suspended solids and TDS. Among these parameters, pH exceeded the upper objective three times in 2017, but the values are consistent with historical data for the Westhope site. DO fell below the minimum objective of 5.0 mg/L twice; in the months of January and February under ice. This can be related to minimal flow during the winter. There were five total suspended solids and four TDS exceedances. The high total suspended solids concentrations occurred during runoff, then again later in the summer, with an extreme concentration in September. High TDS concentrations occurred under ice in January and February, also in August and September.

Biological parameters monitored include fecal coliform and *E. coli* bacteria. Fecal coliform exceeded the 200 colonies per 100 millilitres objective once with a density of 380 colonies per 100 millilitres. *E. coli* densities exceeded the interim objective of 400 colonies per 100 ml once, with a density of 420 colonies per 100 ml. Both exceedances occurred in September, when large numbers of waterfowl were observed at the wildlife sanctuary upstream during sampling.

Pesticide samples were collected at Westhope by ECCC between April and September. Atrazine, Bromoxynil, Dicamba, MCPA, Picloram and 2,4-D were detected. Except for Picloram, these detections were at levels well below their WQOs. Picloram exceeded the guideline of 0.05 μg/L in April and June.

4.2 CHANGES TO POLLUTION SOURCES IN 2017

Development in the Saskatchewan/North Dakota region of the basin in connection with the oil play in the Bakken Formation has the potential to increase areas that are susceptible to erosion. However, 2016 and 2017 saw decreasing growth of the oil and gas industry in this area. The continuing decrease in oil prices led to fewer new wells being constructed and most of the production moving south, out of the Souris River basin to a more cost-effective portion of the Bakken formation.

Oil development and production has the potential of increasing storm water pollution through increases in erosion and can cause a variety of water quality impairments. However, the most prevalent source of pollution is still nonpoint source pollution arising from other sources.

The Souris River basin typically experiences short duration but intense precipitation during the spring and early summer months. These storms can cause overland flooding and rising river levels. Cropping practices that don't use soil and water conservation methods and livestock grazing near and watering in the river are the likely sources of excessive nutrient, sediment, and *E. coli* bacteria concentrations, along with providing conditions for DO depletion. However, this has been lessened in recent years by the installation of animal waste systems and best management practices on agricultural land through a variety of watershed improvement projects throughout the basin on both sides of the border.

Dams frequently have a substantial additive effect on phosphorus loading. Large reservoirs with hypolimnetic releases can contribute to higher phosphorus loads; however, reservoirs in the Lake Winnipeg basin have been shown to sequester large proportions of nutrients and decrease downstream nutrient loads. The reservoirs and dams can become anoxic near the bottom during the winter, which can increase phosphorus release from sediments. Nutrient concentrations at the border sites have historically been above the current objective. The continual release of water throughout the year from the upstream reservoirs seems to have lowered nutrient levels.

Point sources pollution from the cities of Estevan and Minot have been reduced by advanced wastewater treatment. Smaller cities continue to discharge effluent intermittently. All wastewater treatment lagoons in North Dakota are required in their permit to meet the State's water quality standards at the point of discharge. These standards are protective of the objectives set up by the International Souris River Board.

Future impacts to water quality and aquatic ecosystem health include changing agriculture, urban development, energy development, water appropriations that reduce flows and reservoir operations.

4.3 CHANGES TO MONITORING

There are no changes to the monitoring plan for 2018. The 2018 monitoring plan can be found in Appendix F.

4.4 WINTER ANOXIA

Winter hypoxia and anoxia and associated fish kills are the result of very low concentrations of DO that have been documented in the Souris River basin on many occasions in previous years.

Factors contributing to low oxygen levels have not been definitively determined, but are thought to be due to relatively high sediment oxygen demand relative to the volume of liquid water between the ice and sediment (as determined in North Dakota's 2010 Total Maximum Daily Load report on the reach of the Souris River from Sherwood to Lake Darling). As well as low flow conditions, macrophyte decomposition, organic enrichment, photosynthesis suppression under ice and snow, scouring of low head dams during high flow events, and low-level drawdowns in reservoirs contribute to low oxygen levels.

DO concentrations at Sherwood met the water quality objective of 5.0 milligrams per litre for all samples throughout 2017. At Westhope, two low oxygen events occurred; in January and February. To better determine the minimum flow needed to protect these levels, the Board agreed to keep a watch on DO conditions and the USGS and ECCC will attempt to collect DO and ammonia samples when low flow conditions occur in future winters.

5.0 WATER-DEVELOPMENT ACTIVITIES IN 2017

5.1 NORTHWEST AREA WATER SUPPLY PROJECT

The Garrison Diversion Municipal, Rural, and Industrial (MRI) water-supply program, passed by the United States Congress on May 12, 1986, as part of the Garrison Diversion Reformation Act of 1986, authorized the appropriation of federal funds for the planning and construction of water-supply facilities throughout North Dakota. An agreement between the North Dakota State Water Commission and the Garrison Conservancy District in 1986 provided a method through which the agencies can request funding for MRI water-system projects from the Secretary of the Interior. On the basis of this agreement, the Northwest Area Water Supply (NAWS) study was initiated in November 1987.

The NAWS project has been designed to supply a reliable source of treated water to cities, communities, and rural water systems in 10 counties in northwestern North Dakota. The project has an estimated cost of $217 million.

The water supply for the project is Lake Sakakawea, located in the Missouri River system. The annual use authorized under the State of North Dakota water permit is 18,502 cubic decametres (15,000 acre-feet).

Canada is concerned that the NAWS project could permit the interbasin transfer of non-native biota. NAWS would be the first project to divert water across the continental divide to the Hudson Bay drainage basin.

The Province of Manitoba filed suit in U.S. District Court. The court required the project undergo further National Environmental Policy Act (NEPA) review, and placed an injunction on the project.

On April 15, 2005, the Court modified the injunction to allow the construction on the pipeline between Lake Sakakawea and Minot to continue.

On March 24, 2006, the Court modified the injunction to allow additional construction of the Minot High Service Pump Station, the pipeline from the High Service Pump Station to the northern part of the City of Minot, ND, and the pipeline to Berthold, ND, to proceed. It was determined that this construction would not affect treatment decisions. Design work on these projects was completed in 2006 and contract awards were made in 2007 and 2008. All 45 miles of this pipeline were completed by the summer of 2008. Berthold, ND started receiving water in August 2008. The High Service Pump Station started operating in December 2009.

On March 18, 2008, the Court again modified the injunction to allow additional design and construction activities for the entire Northern Tier for features not affecting treatment decisions. The Kenmare-Upper Souris project started serving water in December 2009. The NAWS-All Seasons-Upham pipeline started serving water in September 2009. The Mohall-Sherwood-All Seasons pipeline has planned completion in Spring 2012. The Minot Air Force Base pipeline and the Upper Souris-Glenburn segment north of the Air Force Base have planned completion in 2012. Berthold, the Kenmare-Upper Souris project, and the NAWS-All Seasons-Upham pipeline are currently receiving limited water supply from the Minot and Sundre aquifers.

The construction activity in 2012 revolved around three contracts that were delayed by the flooding in 2011. Two are pipeline contracts connecting Minot's North Hill, the Minot Air Force Base, Glenburn, Upper Souris Water Users System II water treatment facility three miles north of Glenburn, ND, and two connections for the North Prairie Rural Water System to the NAWS project. These projects were completed.

The other contract was for the rehabilitation of the filter bays and associated piping at the Minot Water Treatment Plant Filtration Upgrades as well as the control instrumentation and Supervisory Control and Data Acquisition (SCADA; telemetry) for the entire North Tier project works which were operational by the end of 2012 with substantial completion shortly thereafter.

Work continued on the Supplemental Environmental Impact Statement with the Bureau of Reclamation and their consultant, CardnoENTRIX. A status update was provided to the Federal Court in October 2013.

The Bureau of Reclamation published the NAWS draft Supplemental Environmental Impact Statement in July of 2014.

A final Supplemental Environmental Impact Statement was published in April 2015 and a Record of Decision was published in August 2015.

In 2017, the Court ruled that the Bureau had met its obligations under NEPA and lifted the injunction on the project. Manitoba and Missouri appealed the decision. Litigation continued through 2017.

5.2 WATER APPROPRIATIONS

5.2.1 Background

In 1995, the International Souris River Board adopted a new method for reporting minor project diversions for the purpose of determining apportionment. The new method uses a common set of criteria and ensures that the same criteria are used in Saskatchewan and North Dakota. The method involves reviewing the project lists generated by the Natural Flow Methods Committee and adding newly constructed projects or subtracting cancelled projects each year. The projects that met the criteria in 1993 are used as the benchmark for all future reporting.

5.2.2 Saskatchewan

In 1993 there were 137 minor projects in the Saskatchewan portion of the Souris River basin that met the 1995 criteria. These projects had an annual diversion of 5,099 cubic decametres (4,134 acre-feet). In 2017 there were 621 projects with issued licenses for water use for a total of 60,230 cubic decametres (48,848 acre-feet) in the Saskatchewan portion of the basin. There were no new minor use water licenses approved.

5.2.3 North Dakota

In 1993 there were 12 minor projects in the North Dakota portion of the Souris River basin upstream of Sherwood that met the 1995 criteria. The projects had an annual diversion of 1,257 cubic decametres (1,019 acre-feet). As of December 31, 2016, there were 12 minor projects in the North Dakota portion of the Long and Short Creek basins. The annual diversions totaled 1,425 cubic decametres (1,154 acre-feet).

The diversion from East Branch Short Creek near Columbus, North Dakota, was estimated by correcting for precipitation, evaporation and seepage, and the storage change. The diversion in 2017 was 403 cubic decametres (327 acre-feet). The diversion at the Short Creek reservoir was added to the minor project diversions for the Long and Short Creek basins to obtain the total diversion of 1,994 cubic decametres (1,617 acre-feet) by the United States.

6.0 HYDROLOGIC CONDITIONS IN 2017

The Saskatchewan Water Security Agency reported that 2016/2017 winter precipitation in the Saskatchewan portion of the Souris River basin was well above normal. Hydrologic conditions for the remainder of 2017 varied from below normal in the spring to near record well below normal precipitation conditions in the summer and fall. The estimated precipitation from September 1 to November 1 was 40-60 percent of normal.

The United States Geological Survey (USGS) reported the total volume of flow past the Long Creek at Noonan gage through December 31, 2017 calendar year was 47,397 cubic decametres (38,440 acre-feet). The volume is about 236 percent of the median flow for the past 58 years. The peak discharge for the reporting period January 1 to December 31, 2017 was 61 cms (2,160 cfs), which ranks 15th in 58 years of record.

On December 31, 2017, Rafferty reservoir was at an elevation of 549.52 m (1802.98 ft), or 0.466 m (1.529 ft) higher than at the beginning of the year. Total inflow to Rafferty reservoir in 2017 was 79,038 cubic decametres (64,102 acre-feet). No water was transferred from Rafferty reservoir to Boundary reservoir via the pipeline in 2017.

The main stem inflow to Grant Devine reservoir (Moose Mountain Creek above Grant Devine reservoir) was 39,156 cubic decametres (31,757 acre-feet). Grant Devine reservoir was at an elevation of 561.10 m (1,841.0 ft) on December 31, 2017, or 0.06 m (0.18 ft) lower than at the beginning of the year.

Boundary reservoir received an inflow of 47,416 cubic decametres (38,456 acre-feet) from Long Creek. On December 31, 2017, Boundary reservoir was at an elevation of 559.36 m (1,835.26 ft), or 0.29 m (0.95 ft) higher than at the beginning of the year.

On December 31, 2017, the estimated storage in the five major reservoirs in Saskatchewan (Boundary, Rafferty, Grant Devine, Nickle Lake, and Moose Mountain Lake) was 560,771 cubic decametres (454,618 acre-feet) as compared to storage of 536,037 cubic decametres (434,710 acre-feet) on December 31, 2016.

Figure 1 shows the storage contents of the major reservoirs in the Canadian portion of the Souris River basin for 2016 and 2017.

Recorded runoff for the year for the Souris River near Sherwood was 133,576 cubic decametres (108,334 acre-feet), or about 98 percent of the 1931-2017 long-term mean.

The artificially drained areas of Yellow Grass Ditch and Tatagwa Lake contributed 19,604 cubic decametres (15,899 acre-feet) during 2017.

The peak discharge for the period January 1 to December 31 2017 was 52.4 cms (1,850 cfs).

Figure 2 provides a schematic representation of recorded runoff above Sherwood, North Dakota.

The USGS reported the total flow in 2017 for the Souris River at Sherwood was 200 percent greater than the median flow for the past 87 years of record.

On December 31, 2017, the level of Lake Darling was 486.39 m (1,595.76 ft). The 2017 year-end storage in Lake Darling was 119,706 cubic decametres (97,046 acre-feet), or approximately 5,619 cubic decametres (4,557 acre-feet) less than on December 31, 2016.

The 2017 year-end storage in the J. Clark Salyer National Wildlife Refuge pools was 30,562 cubic decametres (24,787 acre-feet), or 18,611 cubic decametres (15,094 acre-feet) less than on December 31, 2016. The combined year-end storage in Lake Darling and the J. Clark Salyer Refuge pools was 150,268 cubic decametres (121,833 acre-feet), well above the 66,600 cubic decametres (54,000 acre-feet) severe drought criterion.

Figure 3 shows the storage contents of the mainstem reservoirs in the United States.

Recorded runoff for the year for the Souris River at Westhope was 701,824 cubic decametres (569,200 acre-feet) or some 568,247 cubic decametres (460,866 acre-feet) more than entered North Dakota at the Sherwood Crossing. The annual runoff for the Souris River near Westhope was 478 percent of the 1929-2017 long-term mean. The minimum flow for the period was zero cms (zero cfs), which occurred on December 31, 2017. The peak discharge for the period January 1 to December 31, 2017 was 236.8 cms (8,360 cfs) which ranks 3rd highest in 88 years of record.

Manitoba Sustainable Development reported that the spring melt started in late March. The Manitoba tributaries and main stem saw expected rapid rises that peaked in early April. The spring freshet produced very high runoff. The return period of the flows was in the range of 20-year to over 50-year flood events.

After the spring freshet, flows declined on the main stem reaching the lower segment of the normal range from July 1st to winter freeze up. Throughout the early summer of 2017 precipitation was mixed, causing some areas to remain wet from the spring and other areas to dry out. Summer precipitation was generally normal to below normal, however timely rains generally prevented an agricultural drought.

The Manitoba portion of the Souris River basin had received below normal snow cover leading into winter.

Figure 4 shows the monthly releases from Boundary, Rafferty, Grant Devine, and Lake Darling reservoirs.

7.0 SUMMARY OF FLOWS AND DIVERSIONS

7.1 SOURIS RIVER NEAR SHERWOOD

The natural runoff near Sherwood for 2017 was 196,665 cubic decametres (159,501 acre-feet). Depletions in Canada were 41,490 cubic decametres (33,650 acre-feet). The additional water received from the Yellow Grass Ditch and Tatagwa Lake Drain basins was 19,604 cubic decametres (15,899 acre-feet). Total depletions in Canada were 26,511 cubic decametres (21,501 acre-feet) more than the additional water received from the Yellow Grass Ditch and Tatagwa Lake Drain basins. The total volume of water released from Boundary, Rafferty, and Grant Devine reservoirs in Canada in 2017 was 63,812 cubic decametres (51,753 acre-feet), representing 48 percent of the recorded flow at Sherwood, or 32 percent of the computed natural runoff at Sherwood.

A schematic representation of the 2017 flow volumes in the Souris River basin above Sherwood is shown in Figure 2.

The summary of the natural flow computations is provided in Appendix A. Saskatchewan was in surplus by 56,091 cubic decametres (45,492 acre-feet) on December 31, 2017.

The flow of the Souris River at Sherwood was more than 0.113 cms (4 cfs) for the entire year. Accordingly, Saskatchewan complied with the 0.113 cms (4 cfs) provision specified in Recommendation No. 1 of the Interim Measures.

7.2 LONG CREEK AND SHORT CREEK

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 26,681 cubic decametres (21,639 acre-feet), or 236 percent of the long-term mean since 1959.

Recommendation No. 2 of the Interim Measures was met. The increase in runoff on Long Creek between the Western and Eastern Crossings was 20,436 cubic decametres (16,574 acre-feet).

Short Creek, which rises in North Dakota, contributed 20,070 cubic decametres (16,277 acre-feet) to the runoff recorded at Souris River above Sherwood.

7.3 SOURIS RIVER NEAR WESTHOPE

Recorded flow near Westhope during the period of June 1 through October 31, 2017, was 22,015 cubic decametres (17,855 acre-feet). Figure 5 illustrates the recorded flows at Westhope and at Wawanesa near the mouth of the Souris River in Manitoba.

According to the United States Geological Survey, flows recorded at the Souris River near Westhope gage through the December 31, 2017 calendar year were 701,824 cubic decametres (569,200 acre-feet). The calendar year's total flow is about 473 percent of the median flow for the last 88 years.

Due to ice conditions the flows in the Souris River near Westhope were estimated for the periods January 1 to April 2 and October 30 to December 31. The peak daily discharge of 237 cms (8,360 cfs) occurred on April 7th, and ranked 3rd highest in 88 years of record.

The flow at Westhope was not in compliance with the 0.566 cms (20 cfs) minimum flow requirement as specified in Recommendation No. 3(a) of the Interim Measures for the period of October 12 through the 19, the 24, 26, 27, 30 and 31, due to wind fetch and minimal flows.

8.0 WORKPLAN SUMMARY FOR 2017

The International Souris River Board was created by the International Joint Commission in April 2000 when the Commission combined responsibilities previously assigned under two separate references for the Souris River. The previous references were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948).

On June 9, 2005, the Board's mandate was further revised through an exchange of diplomatic notes, assigning water quality functions and the oversight for flood forecasting and operations to the Board. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations was an important step in the evolution of the Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

Since the 2011 flood, much of the focus on the work of the International Souris River Board has been on the Plan of Study and the efforts to obtain a reference to complete the study through a study board. With the establishment of the International Souris River Study Board in 2017, workplan efforts for the International Souris River Board will resume in 2018.

Figure 1

MONTH END CONTENTS OF RESERVOIRS IN CANADA FOR THE YEARS 2016 AND 2017

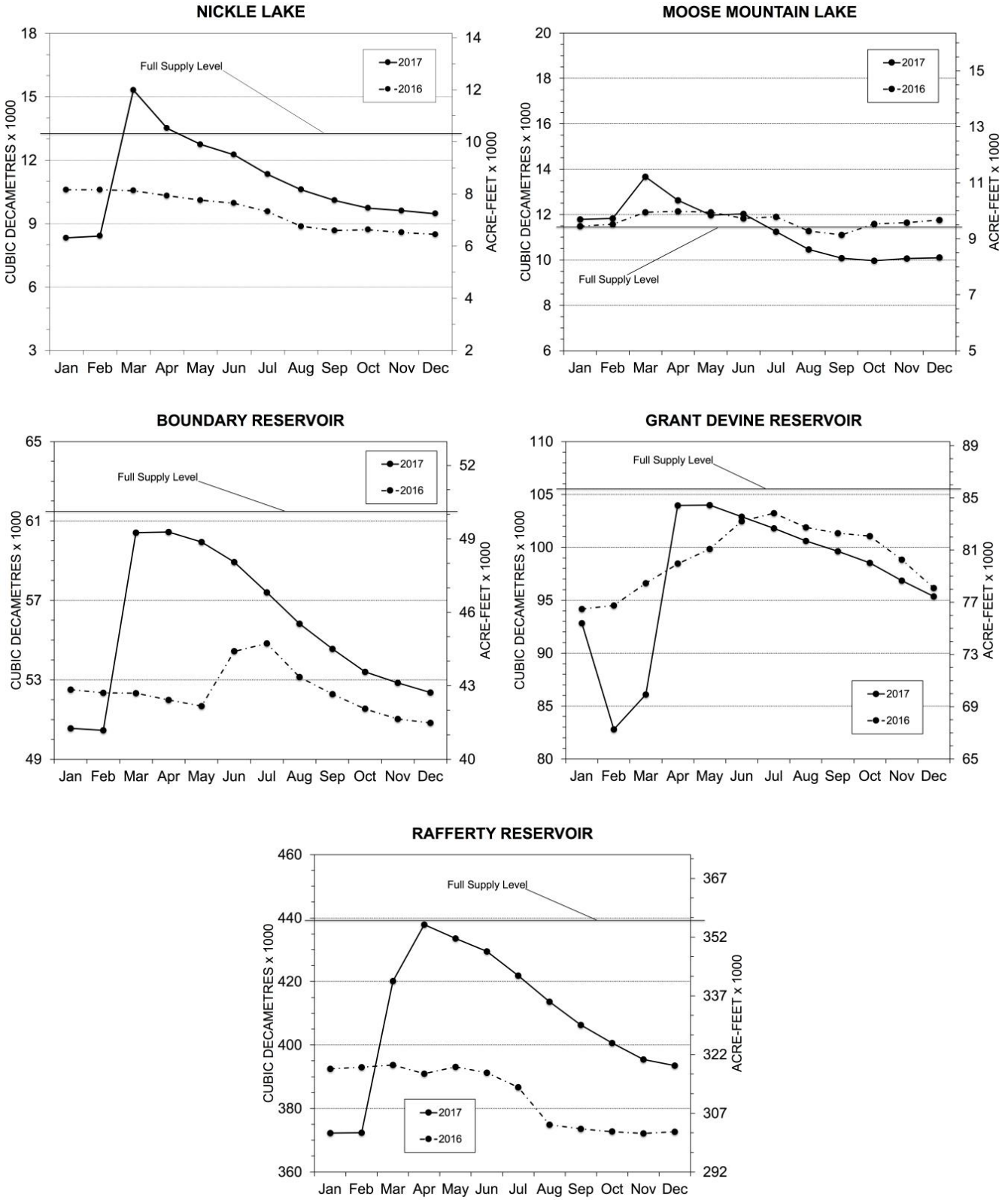


Figure 2

SCHEMATIC REPRESENTATION OF 2017 FLOWS IN THE SOURIS RIVER BASIN ABOVE SHERWOOD, NORTH DAKOTA, U.S.A.

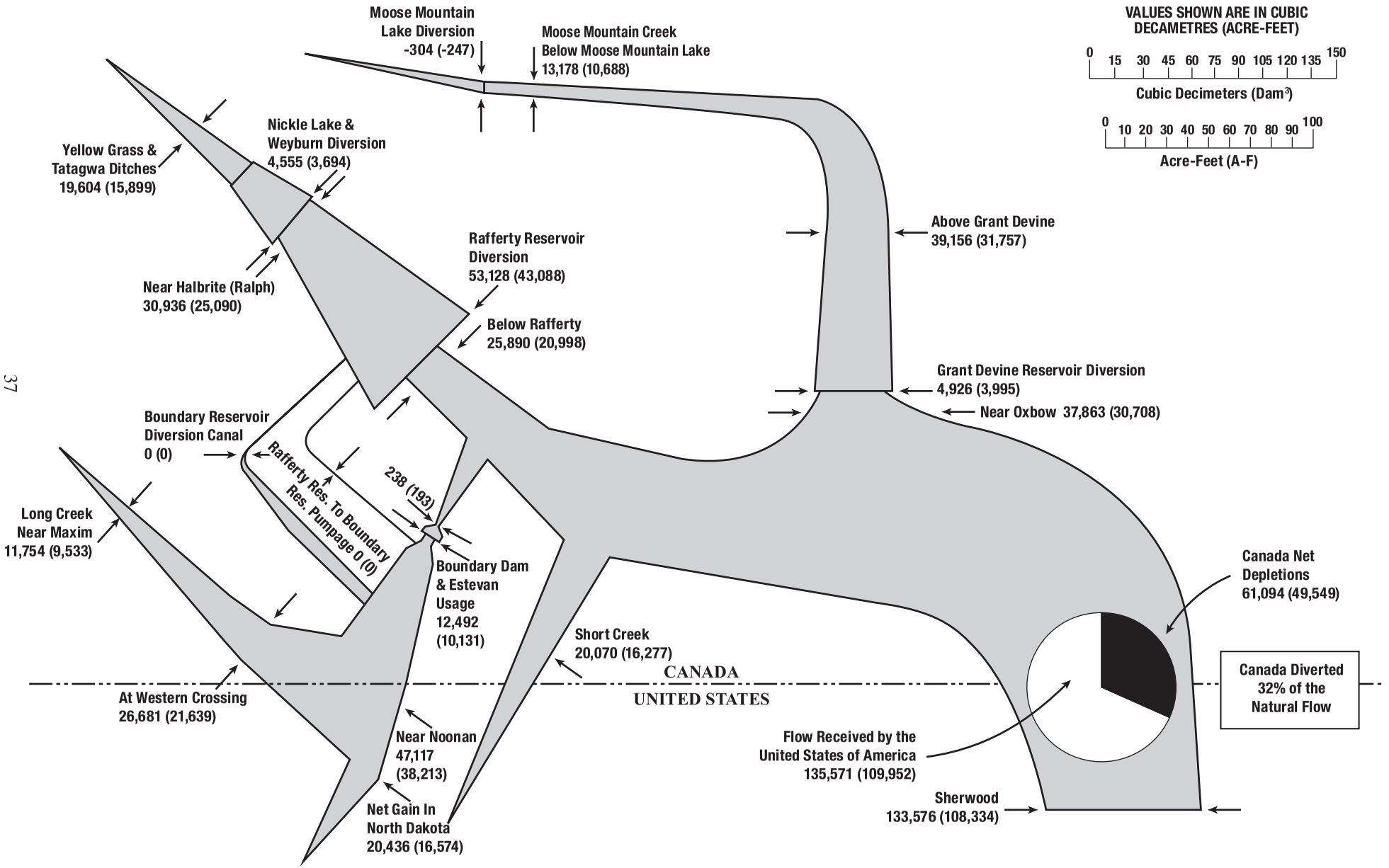


Figure 3

MONTH END CONTENTS OF RESERVOIRS IN USA FOR THE YEARS 2016 AND 2017

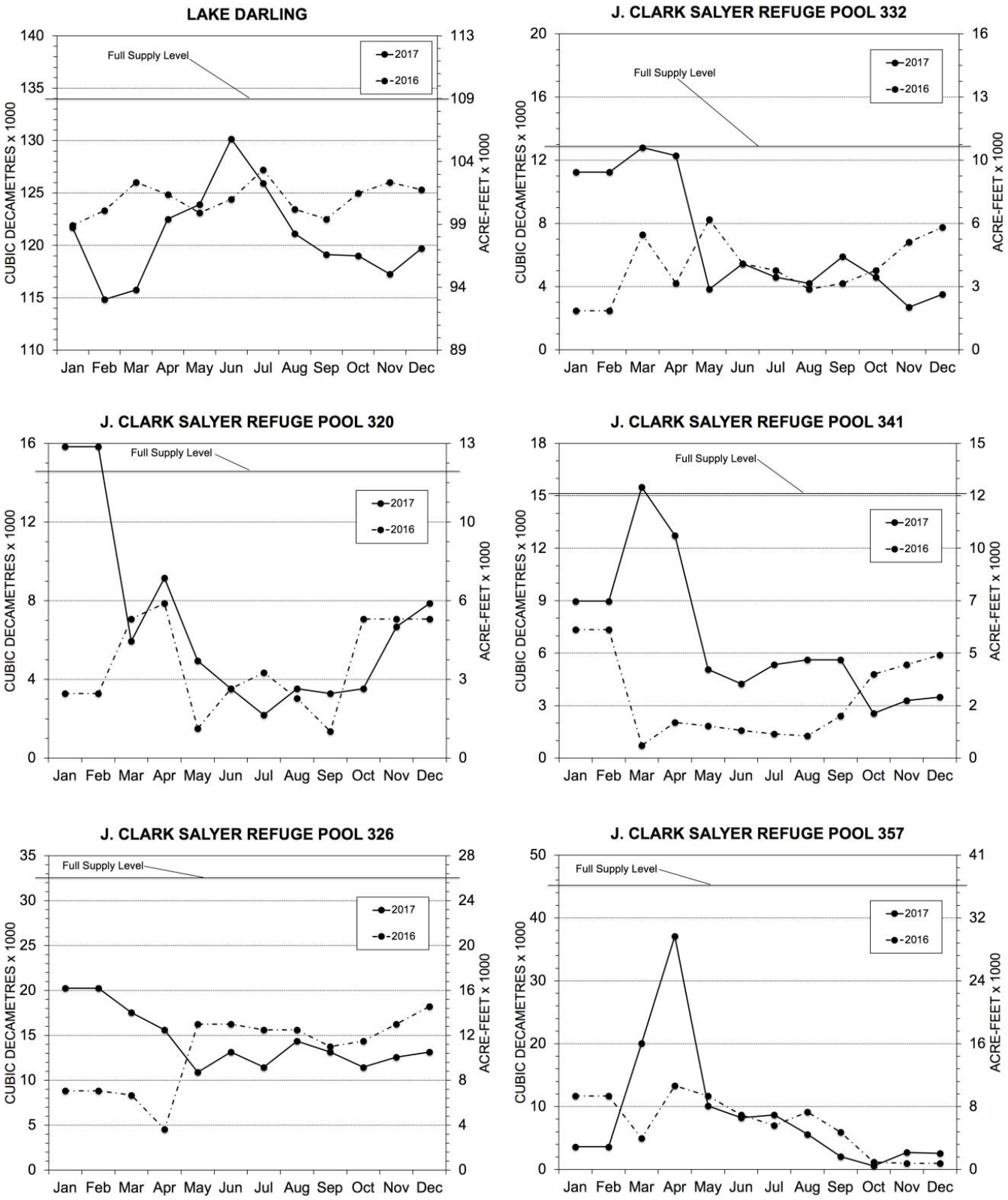


Figure 4

MONTHLY RESERVOIR RELEASES FOR THE YEAR 2017

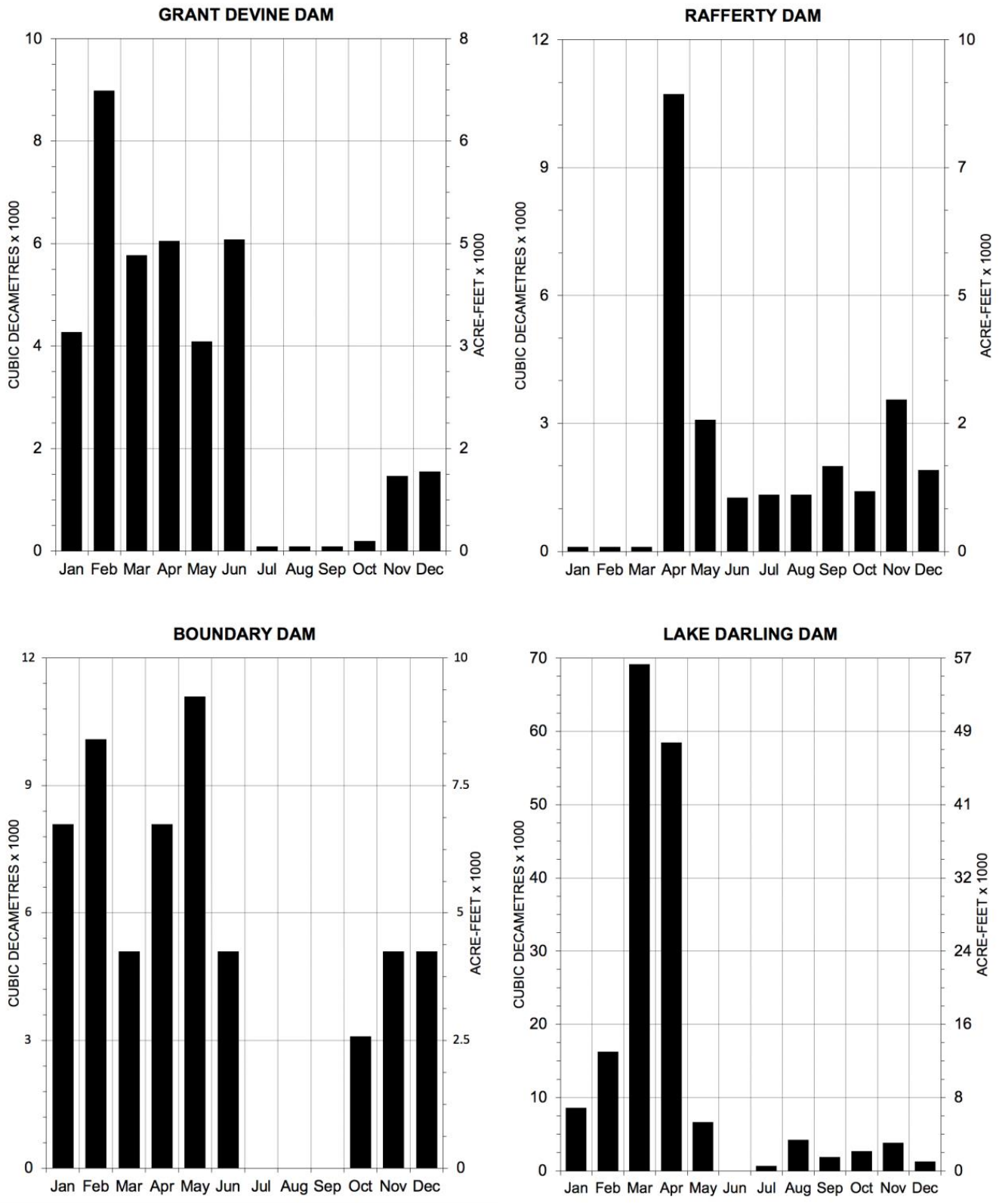
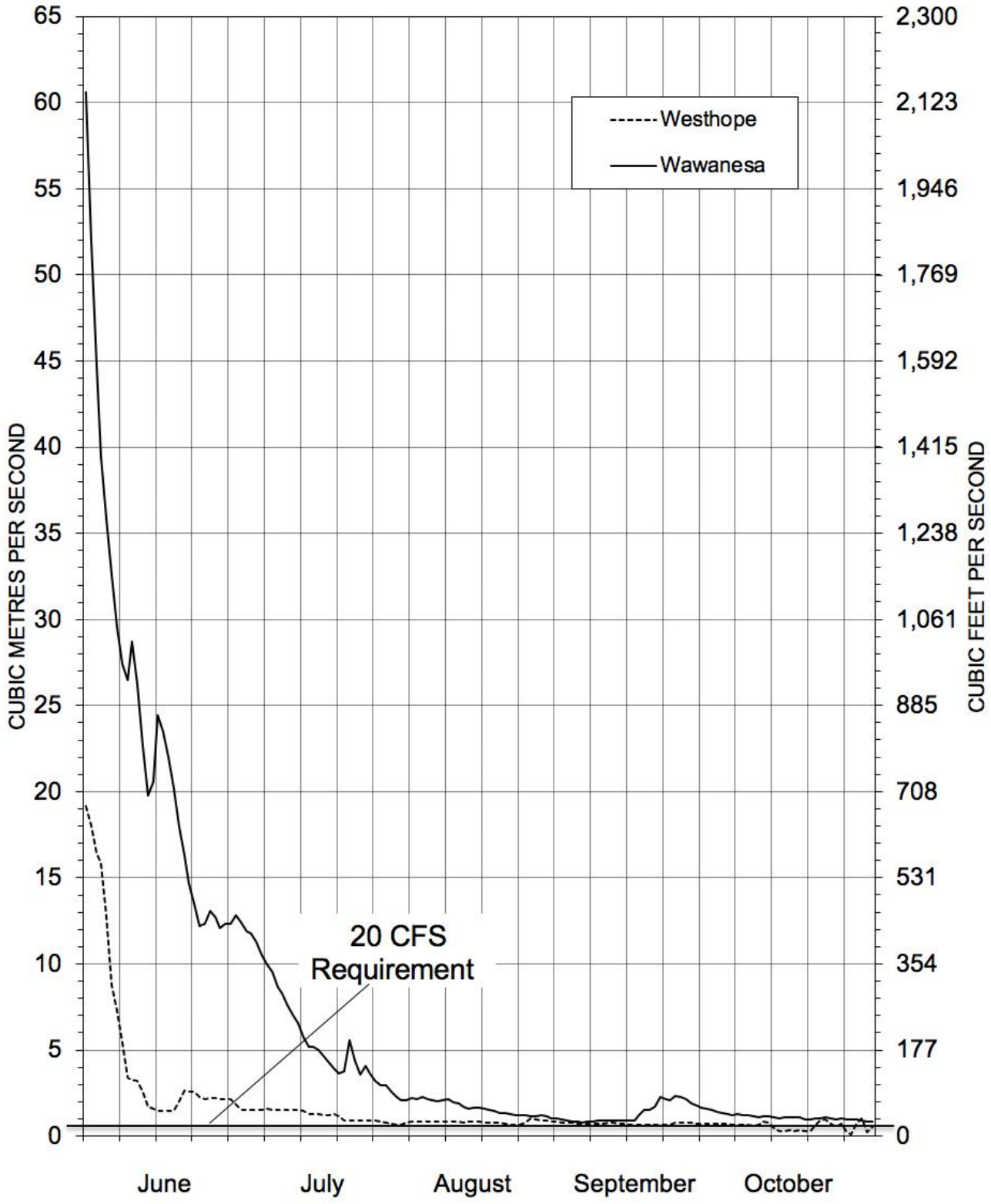
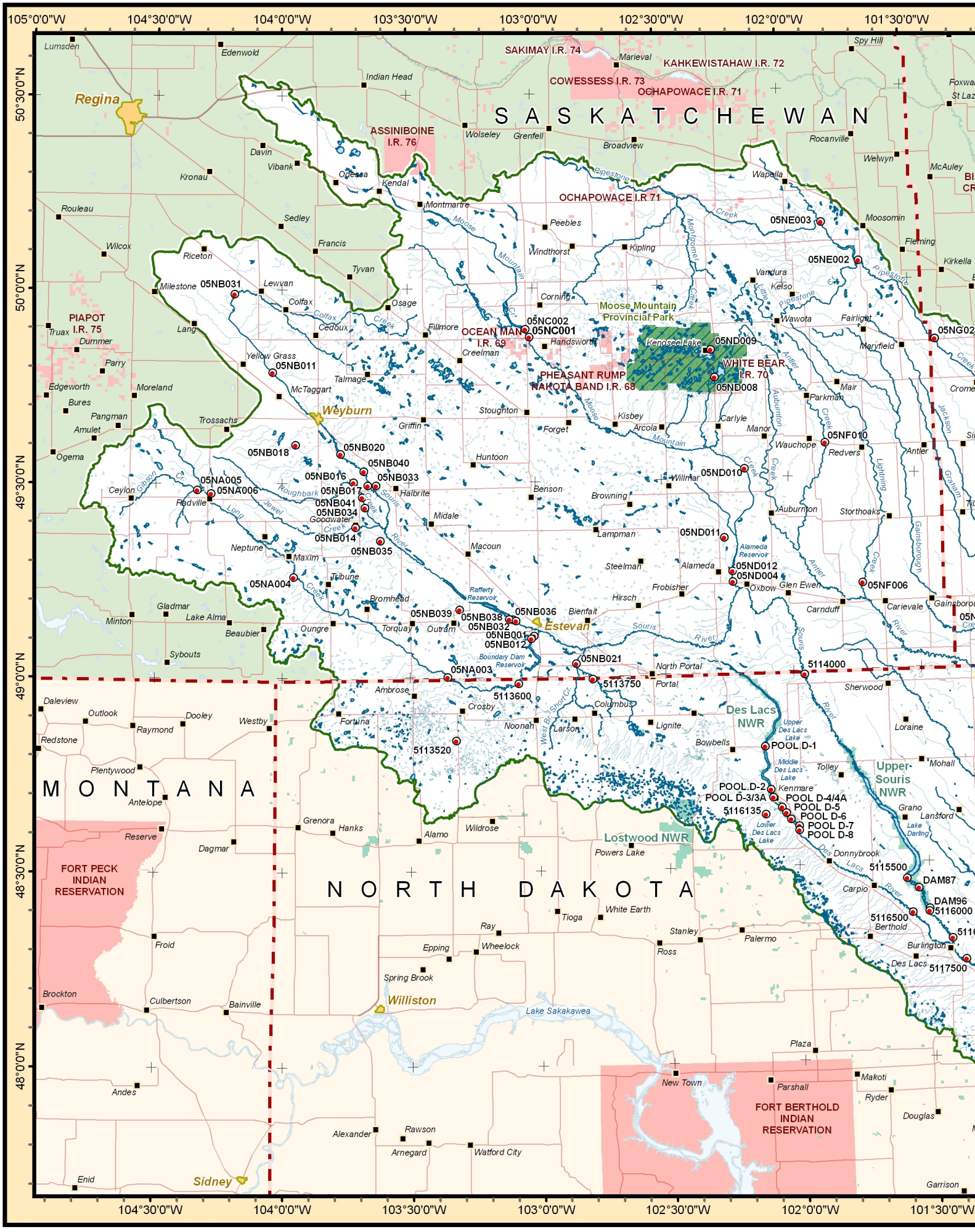


Figure 5

SOURIS RIVER NEAR WESTHOPE
AND
SOURIS RIVER NEAR WAWANESA

June 1, 2017 to October 31, 2017

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48°0'0"N
SASKATCHEWAN
MONTANA
NORTH DAKOTA
Regina
Weyburn
Estevan
Williston
Sidney
SAKIMAY I.R. 74
KAHKEWISTAHAW I.R. 72
COWESSESS I.R. 73
OCHAPOWACE I.R. 71
ASSINIBOINE I.R. 76
PIAPOT I.R. 75
OCEAN MAN I.R. 69
PHEASANT RUMP NAKOTA BAND I.R. 68
WHITE BEAR I.R. 70
FORT PECK INDIAN RESERVATION
FORT BERTHOLD INDIAN RESERVATION
Moose Mountain Provincial Park
Kenosee Lake
Des Lacs NWR
Upper Souris NWR
Lostwood NWR
Lake Sakakawea
05NB031
05NB011
05NB018
05NB020
05NB040
05NB016
05NB033
05NB017
05NB041
05NB034
05NB014
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5116135
5117500
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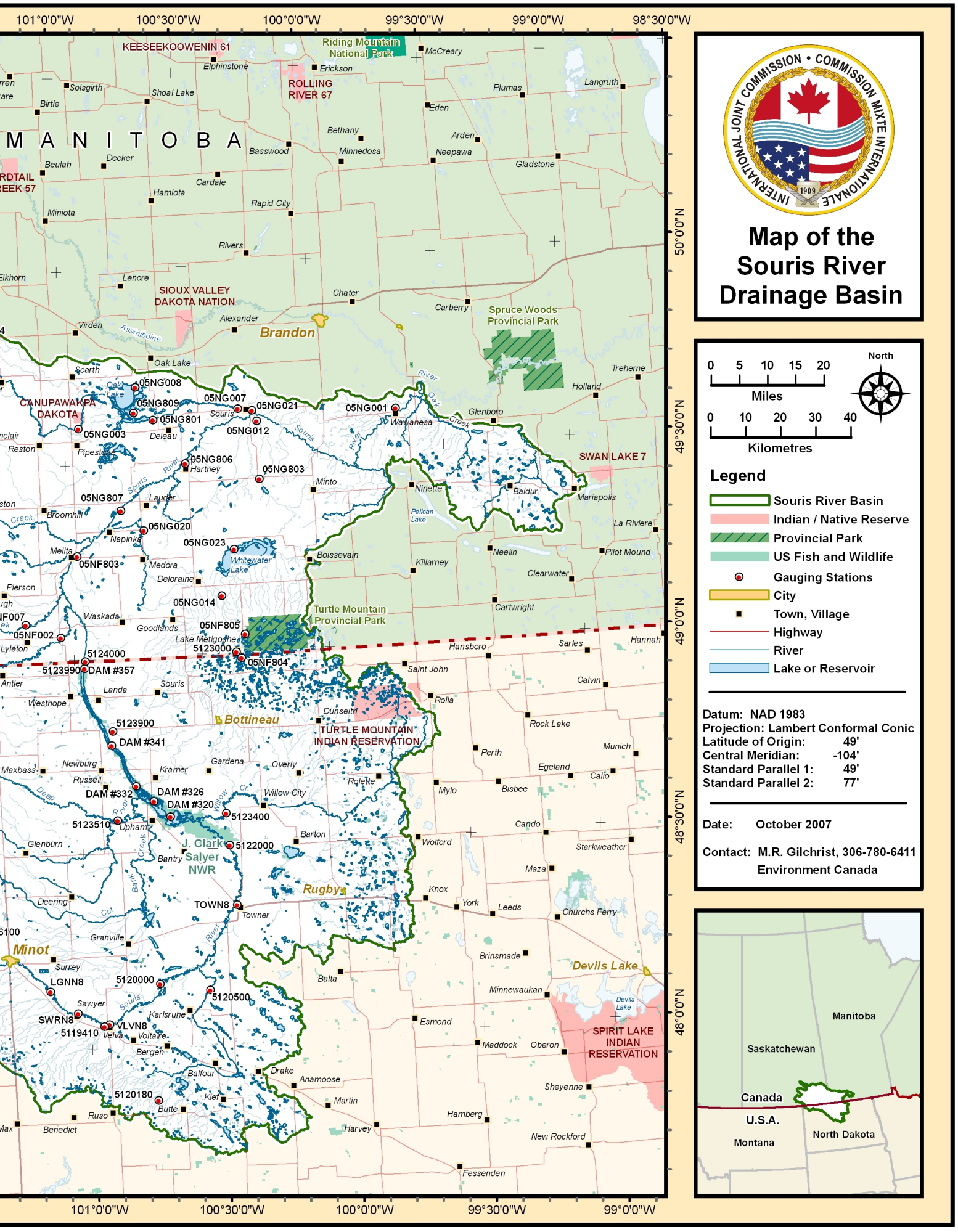
POOL D-4/4A
POOL D-5
POOL D-6
POOL D-7
POOL D-8
DAM87
DAM96
Regina
Edenwold
Lumsden
Indian Head
Marieval
Spy Hill
Wolseley
Grenfell
Broadview
Rocanville
Welwyn
McAuley
Wapella
Davin
Vibank
Odessa
Kendal
Kronau
Montmartre
Rouleau
Sedley
Peebles
Windthorst
Kipling
Moosomin
Fleming
Kirkella
Wilcox
Riceton
Francis
Tyvan
Milestone
Lewvan
Colfax
Osage
Corning
Vandura
Kelso
Wawota
Fairlight
Truax
Lang
Cedoux
Fillmore
Handsworth
Creelman
Maryfield
Dummer
Parry
Yellow Grass
Talmage
McTaggart
Edgeworth
Moreland
Bures
Pangman
Amulet
Trossachs
Griffin
Stoughton
Forget
Kisbey
Arcola
Carlyle
Manor
Parkman
Mair
Wauchope
Redvers
Antler
Ogema
Huntoon
Willmar
Ceylon
Radville
Halbrite
Benson
Browning
Auburnton
Storthoaks
Midale
Lampman
Macoun
Neptune
Maxim
Steelman
Alameda
Glen Ewen
Oxbow
Tribune
Frobisher
Hirsch
Carnduff
Carievale
Gladmar
Lake Alma
Minton
Bromhead
Rafferty Reservoir
Alameda Reservoir
Beaubier
Oungre
Torquay
Outram
Bienfait
Souris River
Sybouts
Boundary Dam Reservoir
North Portal
Portal
Sherwood
Daleview
Outlook
Dooley
Raymond
Westby
Redstone
Ambrose
Crosby
Fortuna
Columbus
Noonan
Larson
Lignite
Bowbells
Loraine
Plentywood
Antelope
Tolley
Mohall
Kenmare
Grano
Lansford
Reserve
Grenora
Hanks
Alamo
Wildrose
Dagmar
Powers Lake
Donnybrook
Froid
Ray
Tioga
White Earth
Stanley
Palermo
Carpio
Berthold
Burlington
Epping
Wheelock
Ross
Spring Brook
Brockton
Culbertson
Bainville
Andes
Plaza
New Town
Parshall
Makoti
Ryder
Douglas
Alexander
Rawson
Arnegard
Watford City
Enid
Garrison



Map of the Souris River Drainage Basin

Datum: NAD 1983
Projection: Lambert Conformal Conic
Latitude of Origin: 49'
Central Meridian: -104'
Standard Parallel 1: 49'
Standard Parallel 2: 77'

Date: October 2007

Contact: M.R. Gilchrist, 306-780-6411
Environment Canada

APPENDIX A

Determination of Natural Flow of Souris River at International Boundary (Sherwood)

DETERMINATION OF NATURAL FLOW OF SOURIS RIVER AT INTERNATIONAL BOUNDARY (SHERWOOD)

All Quantities Reported In Cubic Decametres

FOR THE PERIOD: JANUARY 1 TO December 31, 2017

LONG CREEK BASIN

LARSEN RESERVOIR

1	2	3	4	INFLOW 5 *	6	7	8	9	10	11	12 *	13
STORAGE CHANGE	EVAPORATION	DIVERSION	TOWN OF RADVILLE PUMPAGE	LONG CREEK AT EASTERN CROSSING	LONG CREEK NEAR ESTEVAN	ESTEVAN PIPELINE	DIVERSION CANAL	TOTAL (OUTFLOW)	DIVERSION	MINOR PROJECT DIVERSION	U.S.A. DIVERSION BETWEEN WESTERN & EASTERN CROSSING	**TOTAL DIVERSION LONG CREEK**
				47416								
-231	205	-26 (1+2)	0	0 PIPELINE	60	2130	34387	36577 (6+7+8)	10839 (5-9)	840	403	12056 (3+4+10+11+12)

UPPER SOURIS RIVER BASIN - ABOVE ESTEVAN

NICKLE LAKE RESERVOIR

14	15	16	17	18
STORAGE CHANGE	EVAPORATION	CITY OF WEYBURN PUMPAGE	DIVERSION	CITY OF WEYBURN RETURN FLOW
1050	2718	1759	5527 (14+15+16)	972

ROUGHBARK RESERVOIR

19	20	21
STORAGE CHANGE	EVAPORATION	DIVERSION
723	374	1097 (19+20)

RAFFERTY RESERVOIR

22	23	24
INFLOW	OUTFLOW	DIVERSION
79018	25890 0 PIPELINE	53128 (22-23)

25	26
MINOR PROJECT DIVERSION	**TOTAL DIVERSION UPPER SOURIS RIVER**
1540	60320 (17-18+21+24+25)

LOWER SOURIS RIVER--ESTEVAN TO SHERWOOD

27	28 *	29	30
CITY OF ESTEVAN NET PUMPAGE	SHORT CREEK DIVERSIONS IN U.S.A.	MINOR PROJECT DIVERSION	**TOTAL DIVERSION LOWER SOURIS RIVER**
1653	1592	1000	4245 (27+28+29)

MOOSE MOUNTAIN CREEK BASIN

MOOSE MOUNTAIN LAKE

31	32	33
STORAGE CHANGE	EVAPORATION	DIVERSION
-1600	1296	-304 (31+32)

ALAMEDA RESERVOIR

34	35	36
STORAGE CHANGE	EVAPORATION	DIVERSION
-600	5526	4926 (34+35)

37	38
MINOR PROJECT DIVERSIONS	**TOTAL DIVERSIONS MOOSE MOUNTAIN CREEK BASIN**
1450	6072 (33+36+37)

NON-CONTRIBUTORY BASINS

39	40	41
YELLOW GRASS DITCH	TATAGWA LAKE DRAIN	**TOTAL ADDITIONS**
18814	790	19604 (39+40)

*** DATA CONTRIBUTED BY U.S.G.S.**

SUMMARY OF NATURAL FLOW

42	43 *	44	45	46	47
TOTAL DIVERSION SOURIS RIVER BASIN	RECORDED FLOW AT SHERWOOD	NATURAL FLOW AT SHERWOOD	U.S.A. SHARE	FLOW RECEIVED BY U.S.A.	**SURPLUS (+) OR DEFICIT (-) TO U.S.A.**
			40% OF 44 78670		(46-45) 40% SHARE 56901
82693 (13+26+30+38)	133576	196665 (42+43-41)	50% OF 44	135571 (12+26+43)	(46-45) 50% SHARE

RECOMMENDATION - SECTION 2
ANNUAL FLOW OF LONG CREEK

48	49 *	50
RECORDED FLOW AT WESTERN CROSSING	RECORDED FLOW AT EASTERN CROSSING	**SURPLUS (+) OR DEFICIT (-) FROM U.S.A.**
26681	47117	**20436** (49-48)

APPENDIX B

Equivalents of Measurements

EQUIVALENTS OF MEASUREMENTS

The following is a list of equivalents of measurement that have been agreed to for use in reports of the International Souris River Board.

1 centimetre equals 0.39370 inch
1 metre equals 3.2808 feet
1 kilometre equals 0.62137 mile

1 hectare equals 10 000 square metres
1 hectare equals 2.4710 acres
1 square kilometre equals 0.38610 square mile

1 cubic metre per second equals 35.315 cubic feet per second

The metric (SI) unit that replaces the British acre-foot unit is the cubic decametre (dam^3), which is the volume contained in a cube 10 m x 10 m x 10 m or 1 000 cubic metres.

1 cubic decametre equals 0.81070 acre-feet
1 cubic metre per second flowing for 1 day equals 86.4 cubic decametres
1 cubic foot per second flowing for 1 day equals 1.9835 acre-feet

APPENDIX C

Interim Measures as Modified in 2000

INTERIM MEASURES AS MODIFIED IN 2000

APPENDIX A TO THE DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

1. The Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than 50 percent of that which would have occurred in a state of nature, as calculated by the International Souris River Board. For the purpose of these calculations, any reference to "annual" and "year" is intended to mean the period January 1 through December 31.

   For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall, so far as is practicable, regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metre per second (4 cubic feet per second) when that much flow would have occurred under the conditions of water use development prevailing in the Saskatchewan portion of the Souris River basin prior to construction of the Boundary Dam, Rafferty Dam, and Alameda Dam.

   Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the annual natural flow volume at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control in North Dakota and of evaporation as a result of the project.

   a. Saskatchewan will deliver a minimum of 50 percent of the annual natural flow volume at the Sherwood Crossing in every year except in those years when the conditions given in (i) or (ii) below apply. In those years, Saskatchewan will deliver a minimum of 40 percent of the annual natural flow volume at the Sherwood Crossing.

      i. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 486.095 metres (1594.8 feet); or

      ii. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 485.79 metres (1593.8 feet), and since the last occurrence of a Lake Darling June 1 elevation of greater than 486.095 metres (1594.8 feet) the elevation of Lake Darling has not been less than 485.79 metres (1593.8 feet) on June 1.

   b. Notwithstanding the annual division of flows that is described in (a), in each year Saskatchewan will, so far as is practicable as determined by the Board, deliver to North Dakota prior to June 1, 50 percent of the first 50 000 cubic decametres (40,500 acre-feet) of natural flow which occurs during the period January 1 to May 31. The intent of this division of flow is to ensure that North Dakota receives 50 percent of the rate and volume of flow that would have occurred in a state of

nature to try to meet existing senior water rights.

c. Lake Darling Reservoir and the Canadian reservoirs will be operated (insofar as is compatible with the Projects' purposes and consistent with past practices) to ensure that the pool elevations, which determine conditions for sharing evaporation losses, are not artificially altered. The triggering elevation of 485.79 metres (1593.8 feet) for Lake Darling Reservoir is based on existing water uses in North Dakota, including refuges operated by the U.S. Fish and Wildlife Service. Each year, operating plans for the refuges on the Souris River will be presented to the Board. Barring unforeseen circumstances, operations will follow said plans during each given year. Lake Darling Reservoir will not be drawn down for the sole purpose of reaching the elevation of 485.79 metres (1593.8 feet) on June 1.

   Releases will not be made by Saskatchewan Watershed Authority from the Canadian reservoirs for the sole purpose of raising the elevation of Lake Darling Reservoir above 486.095 metres (1594.8 feet) on June 1.

d. Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow.

e. A determination of the annual apportionment balance shall be made by the Board on or about October 1 of each year. Any shortfall that exists as of that date shall be delivered by Saskatchewan prior to December 31.

f. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the 0.113 cubic metre per second (4 cubic feet per second) minimum flow limit, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. Prior to these releases being made, consultations shall occur between the Saskatchewan Watershed Authority, the U.S. Fish and Wildlife Service, and the State of North Dakota. All releases will be within the specified target flows at the control points.

2. Except as otherwise provided herein with respect to delivery of water to the Province of Manitoba, the State of North Dakota shall have the right to divert, store, and use the waters which originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing under Recommendation (1) above; provided, that any diversion, use, or storage of Long Creek water shall not diminish the annual flow at the eastern crossing of Long Creek into Saskatchewan below the annual flow of said Creek at the western crossing into North Dakota.

3. (a) In addition to the waters of the Souris River basin which originate in the Province of Manitoba, that Province shall have the right, except during periods of severe drought, to receive for its own use and the State of North Dakota shall deliver from any available source during the months of June, July, August, September, and October of each year, six thousand and sixty-nine (6,069) acre-feet of water at the Westhope Crossing regulated so far as practicable at the rate of twenty (20) cubic feet per second except as set forth hereinafter: provided, that in delivering such water to Manitoba no account shall be taken of water crossing the boundary at a rate in excess of the said 20 cubic feet per second.

   (b) In periods of severe drought when it becomes impracticable for the State of North Dakota to provide the foregoing regulated flows, the responsibility of the State of North Dakota in this connection shall be limited to the provision of such flows as may be practicable, in the opinion of the said Board of Control, in accordance with the objective of making water available for human and livestock consumption and for household use. It is understood that in the circumstances contemplated in this paragraph the State of North Dakota will give the earliest possible advice to the International Souris River Board of Control with respect to the onset of severe drought conditions.

4. In event of disagreement between the two sections of the International Souris River Board of Control, the matters in controversy shall be referred to the Commission for decision.

5. The interim measures for which provision is herein made shall remain in effect until the adoption of permanent measures in accordance with the requirements of questions (1) and (2) of the Reference of January 15, 1940, unless before that time these interim measures are qualified or modified by the Commission.

APPENDIX D

Board Directive from January 18, 2007

DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

The International Souris River Board was created by the International Joint Commission in April 2000 when it amalgamated the Souris River basin responsibilities previously assigned to the Commission in two separate references by the governments of Canada and the United States. The two references were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948). The International Souris River Board's mandate changed further through an exchange of diplomatic notes on June 9, 2005 assigning water quality functions and the oversight for flood forecasting and operations as described in Section 4 below. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations is a step in the evolution of the International Souris River Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

This directive replaces the April 11, 2002 Directive to the International Souris River Board and sets out the mandate under which the Board will operate.

1. Pursuant to the Boundary Waters Treaty of 1909 and related agreements, responsibilities have been conferred on the Commission to ensure compliance with apportionment measures for the waters of the Souris River, to investigate and report on water requirements and uses as they impact the transboundary waters of the Souris River basin, and to assist in the implementation and review of the Joint Water Quality Monitoring Program pursuant to the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.

2. The apportionment measures derive from the approvals given by the governments of Canada and the United States, by letters of March 20, 1959 and April 3, 1959 respectively, to the recommendations made by the Commission in paragraph 22 of its report to the governments of March 19, 1958. Subsequently, with the signing of the Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin on October 26, 1989 (hereafter referred to as the 1989 Agreement), the Interim Measures for apportionment of the Souris River at the Saskatchewan-North Dakota boundary were revised as described in Annex B of the 1989 Agreement. By letters of February 28, 1992, the Commission was requested to monitor compliance with the measures as modified in the 1989 Agreement. By letters of December 20 and 22, 2000, the governments amended Annex B of the 1989 Agreement. The attached Appendix A is a consolidation of the apportionment measures against which the Commission is to monitor compliance.

3. By letters of January 12, 1948, the governments requested the Commission to undertake investigations of water requirements and uses arising out of existing dams and other works or projects in the mid-continent portion of the Canada-United States boundary, including the Souris River basin, and to make advisory recommendations.

4. By exchange of diplomatic notes between the governments of Canada and the United States dated January 14 and June 9, 2005, the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin was formally revised to include a reference pursuant to Article IX of the Boundary Waters Treaty which assigned water quality responsibilities contained in the 1989 Agreement to the Commission. The Commission was requested to assist with the implementation and review of the Joint Water Quality Monitoring Program. On October 21, 2005 at the October 2005 Commission's meeting with governments, the U.S. State Department read a statement into the Commission's formal record that the U.S. State Department is of the opinion the Commission has the authority and has obtained the notification it needs from the U.S. State Department to proceed with carrying out the flood related responsibilities for the Souris River. On April 6, 2006 at the April 2006 Commission's meeting with governments, the Department of Foreign Affairs and International Trade indicated that the Board should be assigned these responsibilities. It is recognized that Article X of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin designates the entities responsible for operation and maintenance of the improvements mentioned in the 1989 Agreement and that the operations will be in accordance with the Operating Plan shown in Annex A of the 1989 Agreement. The Department of Army is the entity designated responsible for flood operations within the United States. The Government of Saskatchewan is the Canadian entity designated responsible for flood operations within the Canadian Province of Saskatchewan.

5. The Board's mandate is to support the Commission's initiative to explore and encourage the development of local and regional capacity with the objective of preventing and resolving transboundary disputes regarding the waters and aquatic ecosystem of the Souris River and its tributaries and aquifers. This would be accomplished through the application of best available science and knowledge of the aquatic ecosystem of the basin and an awareness of the needs, expectations and capabilities of residents of the Souris River basin. The Board's mandate will be accomplished by performing the tasks identified in Clause 6 below.

6. The Board's duties shall be to:

   (i) Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.

   (ii) Oversee the implementation of compliance with the Interim Measures As Modified For Apportionment of the Souris River as described in Appendix A of this document by:
   - identifying an adequate hydro-climatic monitoring network to support the determination of natural flow and apportionment balance,
   - encouraging the appropriate authorities to establish and maintain hydro-climatic monitoring and information collection networks and reporting

systems to ensure suitable information is available as required for the determination of natural flow and apportionment balance,

- informing the Commission, in a timely manner, of critical water supply or flow conditions in the basin,
- encouraging appropriate authorities to take steps to ensure that apportionment measures are met, and
- preparing an annual report and submitting it to the Commission.

(iii) Assist the Commission in the review of a Joint Water Quality Monitoring Program (referred to hereafter as "the Program") by:

- developing recommendations on the Program and the setting of water quality objectives,
- exchanging data provided by the Program on a regular basis,
- collating, interpreting, and analyzing the data provided by the Program,
- reviewing the Program and the water quality objectives at least every five years and developing recommendations, as appropriate, to the Commission to improve the Program and the objectives, and
- preparing an annual report containing:
  - a summary of the principal activities of the Board during the year with respect to the Program,
  - a summary of the principal activities affecting water quality in the Souris River Basin during the year,
  - a summary of the collated, interpreted, and analyzed data provided by the Program,
  - a summary of the water quality of the Souris River at the two locations at which it crosses the International Boundary,
  - a section summarizing any definitive changes in the monitored parameters and the possible causes of such changes,
  - a section discussing the water quality objectives for the Souris River at the Saskatchewan/North Dakota boundary and at the North Dakota/Manitoba boundary as established and revised pursuant to the 1989 Agreement,
  - a section summarizing other significant water quality changes and the possible causes of such changes, and
  - recommendations on new water quality objectives or on how existing water quality objectives can be met, including suggestions on water quality as it relates to water quantity during periods of low flow, in the event that the annual report indicates that the water quality objectives have not been attained as a result of activities pursued under the 1989 Agreement.

(iv) Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin by:

- ensuring mechanisms are in place for coordination of data exchange, flood forecasts and communications related to flood conditions and operations;
- determining whether the operations under the 1989 Agreement should proceed based on the Flood Operation or Non-Flood Operation of the Operating Plan, which is Annex A to the 1989 Agreement, using its criteria and informing designated agencies of this determination;
- reporting to the Commission on any issues related to flood operations and management; and
- providing the Commission and the designated entities under the 1989 Agreement recommendations on how flood operations and coordination activities could be improved.

(v) Report on aquatic ecosystem health issues in the watershed, regularly informing the Commission on the state and implications of aquatic ecosystem health, and encourage the appropriative authorities to establish and maintain water quality and other monitoring and information collection networks and reporting systems to ensure suitable information is available as required for the determination of the health of the aquatic ecosystem.

(vi) Carry out such other studies or activities as the Commission may, from time to time, request.

(vii) Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year. The work plan shall be submitted annually to IJC for review.

7. The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year.

8. The Board shall coordinate and collaborate with other agencies and institutions both within and outside the Souris River basin as may be needed or desirable, and facilitate the timely dissemination of pertinent information within the basin. The Board shall keep the Commission informed of these activities.

9. The Board shall have an equal number of members from each country. The Commission shall normally appoint each member for a three-year term. Appointments may be renewed for additional terms. Members shall act in their personal and professional capacity, and not as representatives of their countries, agencies or institutions. The Commission shall appoint Canadian and United States co-chairs of the Board and will strive to appoint chairs with complementary expertise that encompasses a broad spectrum of basin issues.

10. The co-chairs of the Board shall be responsible for maintaining proper liaison between the Board and the Commission, and among the Board members.

11. The co-chairs shall ensure that members of the Board are informed of all instructions, inquiries, and authorizations received from the Commission and also of activities undertaken by or on behalf of the Board, progress made, and any developments affecting such progress.

12. The co-chairs may appoint secretaries of the Board who, under the general supervision of the co-chairs, shall carry out such duties as are assigned by the co-chairs or the Board as a whole.

13. The Board may establish such committees and working groups as may be required to fulfill its responsibilities in a knowledgeable and effective manner. The Commission shall be kept informed of the duties and composition of any committee or working group.

14. Unless other arrangements are made with the Commission, members of the Board, committees, or working groups shall make their own arrangements for reimbursement of necessary expenditures for travel or other related expenses.

15. The Board shall inform the Commission in advance of plans for any meetings, or other means of involving the public in Board deliberations, and shall report to the Commission, in a timely manner, on these and any other presentations or representations made to the Board.

16. The Board shall conduct its public outreach activities in accordance with the Commission's public information policies and shall maintain files in accordance with the Commission policy on segregation of documents.

17. Prior to their release, the Board shall provide the text of media releases and other public information materials to the Secretaries of the Commission for review by the Commission's Public Information Officers.

18. The Board shall submit an annual report covering all of its activities, including the annual report regarding the Program and the work plan, as described in Section 6 above, to the Commission, at least three weeks in advance of the Commission's fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive. Reports shall be submitted in a format suitable for public release and electronic copies shall be provided to each of the Commission's section offices.

19. Reports, including annual reports, minutes and correspondence of the Board shall, normally, remain privileged and be available only to the Commission and to members of the Board and its committees until their release has been authorized by the Commission. The Board shall provide minutes of Board meetings to the Commission within 45 days of the close of the meeting in keeping with the Commission's April 2002 Policy Concerning Public Access to Minutes of Meetings. The minutes will subsequently be put on the Commission's web site.

20. If, in the opinion of the Board or of any member, any instruction, directive, or authorization received from the Commission lacks clarity or precision, the matter shall be referred promptly to the Commission for appropriate action.

21. The Board shall operate by consensus. In the event of any disagreement among the members of the Board which they are unable to resolve, the Board shall refer the matter forthwith to the Commission for decision.

22. The Commission may amend existing instructions or issue new instructions to the Board at any time.

Signed this 18th day of January, 2007

Elizabeth Bourget
Secretary
United States Section

Murray Clamen
Secretary
Canadian Section

APPENDIX E

Water Quality Data for Sherwood and Westhope

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - SASKATCHEWAN/NORTH DAKOTA BOUNDARY
05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median (max - min) #samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max - min) #samples	2017 DATA % detectable	2017 % exceedance
Biological Parameters								
Fecal Coliform	200/100 ml	#/100 ml	54.5 (1200 - <1) 122	90	19	NS	62.5	13
E. coli [a]	(400/100 ml)[c]	#/100 ml	705 (600 - <5) 51	85	4	155 (340 - <5) 4	75	0
Inorganic Parameters								
Ammonia (un-ionized as N)	***	mg/L	0.004 (0.33 – 0.001) 183	calculated	-	0.005 (0.022 – 0.002) 8	calculated	-
Chloride	100	mg/L	34.6 (220 - 4) 194	100	9	41.2 (83.7 – 9.05) 8	100	0
Fluoride	1.5	mg/L	0.2 (1.80 - <0.1) 198	90	0.5	0.18 (0.29 - 0.1) 8	100	0
$NO_2 + NO_3$ (as N) dissolved	1.0	mg/L	0.06 (1.40 - <0.04) 187	59	1	0.05 (0.45 - <0.04) 8	62.5	0
Phosphorus (total P)	0.10	mg/L	0.23 (1.90 - 0.03) 199	100	87	0.19 (0.34 - 0.12) 8	100	100
Sodium	100	mg/L	126 (532 - 14) 197	100	63	134 (326 – 71.9) 8	100	88
Sulfate	450	mg/L	270 (1000 - 48) 198	100	14	410 (568 - 258) 8	100	75
Arsenic (total)	50	µg/L	4.0 (28.3 – <1.0) 190	97	0	4.2 (10.6 – 3.2) 8	100	0
Barium (total)	1,000	µg/L	98 (200 – 14.7) 190	69	0	79.1 (86.4- 42.0) 8	100	0
Boron (total)	500	µg/L	185 (3500 - 40) 158	100	7	164 (438 - 128) 8	100	0
Beryllium (total) [b]	100	µg/L	0.04 (1.98 - <0.01) 100 [b]	49 [b]	0 [b]	0.014 (0.139 - 0.009) 8	100	0
Cadmium (total) [b]	**27	µg/L	0.04 (0.20 - 0.01) 100 [b]	70 [b]	0 [b]	0.05 (0.11 - 0.01) 8	75	0
Chromium (total) [b]	50	µg/L	0.60 (3.5 - 0.25) 100 [b]	81 [b]	0 [b]	0.43 (3.20 - 0.10) 8	37	0
Cobalt (total) [b]	50	µg/L	0.86 (2.20 - 0.25) 100 [b]	96 [b]	0 [b]	0.63 (1.94 - 0.23) 8	88	0
Copper (total)	**30	µg/L	2.40 (18.6 – 0.80) 189	93	0	2.15 (5.60 - 1.30) 8	88	0
Iron (total)	300	µg/L	610 (5870 – 8.0) 189	100	76	517 (3770 - 198) 8	100	75

* in historic dataset, values below detection limits (<) are included at ½ detection limit for median calculations; historic dataset is from 1991 - 2016 unless otherwise indicated [a] E. coli sampling started in 2008, [c] [b] historic data calculated from 2003 – 2016 due to analytical method changes **value shown is based on hardness of 300 mg/L, actual objective is a hardness-based equation ***un-ionized ammonia is calculated using temperature and pH, % detectable not applicable

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - SASKATCHEWAN/NORTH DAKOTA BOUNDARY
05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median (max - min) #samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max - min) #samples	2017 DATA % detectable	2017 %exceedance
Lead (total) [b]	**13	µg/L	0.55 (4.54 - 0.10) 100 [b]	98 [b]	0 [b]	0.27 (2.13-0.09) 8	100	0
Mercury	0.5 ug/g in fish flesh	µg/g	NS	NS	NS	NS	NS	
Molybdenum (total)	10	µg/L	3.00 (45.0 - 0.48) 190	95	5	4.38 (7.20 – 1.57) 8	100	0
Nickel (total)	**220	µg/L	3.90 (11.00 – 1.70) 194	100	0	4.25 (6.40 - 2.50) 8	100	0
Selenium (total)	5	µg/L	1.00 (14.0 - 0.211) 190	51	1	0.65 (1.20 - 0.40) 8	88	0
Zinc (total) [b]	30	µg/L	5.00 (20.10 – 1.00) 100 [b]	84 [b]	0 [b]	8.5 (18.0 - <4.0) 8	37	0
Miscellaneous								
Total Dissolved Solids	1,000	mg/L	813 (2310 - 304) 95	calculated	27	957 (1370 - 500) 8	calculated	62
Total Suspended Solids	the lesser of 10 mg/L or 10% over ambient	mg/L	19.0 (256 - <1) 198	77	25***	13.25(140 -<15) 8	50	50***
pH (range)	8.5-6.5	standard units	8.2 (9.2 – 6.9) 236	100	14	8.2 (8.3 – 9.9) 8	100	38
Dissolved Oxygen (conc.)	>5.0	mg/L	8.6 (19.4 - 0.3) 239	100	13	9.15 (11.3 – 5.2) 8	100	25
Aesthetics		visual	NS			NS		
Oil and Grease		visual	NS			NS		

* in historic dataset, values below detection limits (<) are calculated at ½ detection limit; dataset is from 1991 - 2016 unless otherwise indicated
[b] historic data calculated from 2003 – 2016 due to detection limit changes (however, no exceedances in detectable values before 2003)
**value shown is based on hardness of 300 mg/L, actual objective is a hardness-based equation
*** In 2008 detection limit went up to <15, so possible water quality objective exceedances that couldn't be documents.
NS: Not Sampled
calculated: parameter: calculated from other measured values, % detectable not applicable

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - SASKATCHEWAN/NORTH DAKOTA BOUNDARY
05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA** Median (max-min) # samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max-min) # samples	2017 DATA % detectable	2017 %exceedance
Organic Parameters								
Atrazine	2	µg/L	0.0028 (0.030 - <0.001) 37	59	0	5 < DL 0.001, 1 sample 0.003	17	0
Bromoxynil	5	µg/L	38 <DL 0.001, 1 sample 0.23	2.5	0	(<DL 0.001) 6	0	0
Carbaryl	90	µg/L	(< DL 0.001) 27	0	0	(<DL 0.001) 6	0	0
a-Chlordane	0.0043	µg/L	(<DL 0.001) 16	0	0	(< DL 0.00048) 6	0	0
g-Chlordane	0.0043	µg/L	NS	-	-	NS	-	-
DDT	0.001	µg/L	(<DL 0.001)16	0	0	NS	-	-
Dieldrin	0.0019	µg/L	(< DL 0.001) 16	0	0	NS	-	-
Dicamba	In development	µg/L	(< DL 0.001) 16	0	0	(<DL 0.001) 6	0	0
Diclofop-methyl	In development	µg/L	NS	-	-	NS	-	-
Heptachlor	0.0038	µg/L	(<DL 0.001)16	0	0	NS	-	-
MCPA	0.20	µg/L	0.0028 (0.059 - <0.001) 26	61	0	(<DL 0.001) 6	0	0
Parathion	0.04	µg/L	(<DL 0.01)16	0	0	NS	-	
Phenols (total)	1.0	µg/L	* See below			* See below	-	
Picloram	0.05	µg/L	38 <DL 0.001, 1 sample 0.58	2.5	2.5	(<DL 0.001) 6	0	0
Polychlorinated biphenyl (PCB total)	0.001	µg/L	(< DL 0.001) 16	0	0	NS	NS	
Triallate	0.57	µg/L	<0.0028 (0.059 - <0.001) 34	9	0	(< DL 0.001) 6	0	0
Trifluralin	0.10	µg/L	<001 (0.081 - <0.001) 10	40	0	(< DL 0.001) 6	0	0
2,4-D	4.0	µg/L	0.009 (0.069 - < 0.004) 28	86	0	0.013 (0.018 - <0.004) 6	83	0

** For Pesticides, historic data values below detection limits (<) are calculated at ½ detection limit; dataset is from 2001 - 2016 unless otherwise indicated. There are frequently multiple detection limits within the date range.

* Phenols are difficult to capture in a table due to the variable detection limits per sample as a result of the analysis method. Of the 167 samples taken 1997 – 2016, only 52 were above detection limits. However, detection limits ranged from < 1 µg/L to <50 µg/L. Detectable values ranged from 1 µg/L to 60 µg/L. This means detections were not possible below the water quality objective. For 2017, the detection limit was <50 µg/L, with 4 of 7 samples below detection limits. The detectable values were 19 µg/L, 66 µg/L, and 49 µg/L.

NS: Not Sampled DL: Detection Limit

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY
US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median (max - min) #samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max - min) #samples	2017 DATA % detectable	2017 % exceedance
Biological Parameters								
Fecal Coliform	200/100 ml	#/100 ml	7 (1900 - <2) 204	60.8	4	5 (380 - <2) 8	62.5	13
E. coli [a]	(400/100 ml)[c]	#/100 ml	4.5 (2800 - <2) 70	58.6	3	9 (420 - <2) 8	62.5	13
Inorganic Parameters								
Ammonia (un-ionized as N)	***	mg/L	0.004 (0.425 – 0.0) 199	calculated	-	0.009 (0.090 – 0.0) 8	calculated	-
Chloride	100	mg/L	34.6 (297 - 6.2) 206	100	4	30.2 (59.7 - 12.1) 8	100	0
Fluoride	1.5	mg/L	0.19 (0.87 - <0.01) 205	99.5	0	0.15 (0.19 - 0.08) 8	100	0
$NO_2 + NO_3$ (as N) dissolved	1.0	mg/L	<0.01 (1.11 - <0.01) 205	51.2	0	<0.01 (0.29 - <0.01) 8	62.5	0
Phosphorus (total P)	0.10	mg/L	0.310 (4.52 - 0.091) 204	100	99	0.217 (0.429 - 0.163) 8	100	100
Sodium	100	mg/L	152 (1040 - 19) 206	100	80	167 (265 - 35) 8	100	88
Sulfate	450	mg/L	294 (3490 - 38) 206	100	20	489 (699 - 133) 8	100	62
Arsenic (total)	50	µg/L	4.5 (33.4 - 0.6) 187	100	0	6.2 (12.4 - 2.6) 8	100	0
Barium (total)	1,000	µg/L	87.0 (631 - 32.3) 205	97.6	0	87.1 (159 - 42.7) 8	100	0
Boron (total)	500	µg/L	197 (2080 - 41) 173	99.4	2	185 (252 - 63) 8	100	0
Beryllium (total) [b]	100	µg/L	0.016 (0.116 - <0.001) 109 [b]	99 [b]	0 [b]	0.014 (0.139 - 0.009) 8	100	0
Cadmium (total) [b]	**27	µg/L	0.024 (0.120 - 0.006) 109 [b]	100 [b]	0 [b]	0.027 (0.078 - 0.015) 8	100	0
Chromium (total) [b]	50	µg/L	0.30 (2.36 - 0.07) 109 [b]	100 [b]	0 [b]	0.27 (2.51 - 0.20) 8	100	0
Cobalt (total) [b]	50	µg/L	0.50 (4.97 - 0.17) 109 [b]	100 [b]	0 [b]	0.61 (2.30 - 0.32) 8	100	0
Copper (total)	**30	µg/L	1.66 (21.00 - 0.32) 205	94	0	2.37 (4.67 - 1.59) 8	100	0
Iron (total)	300	µg/L	336 (14,500 - 14) 190	100	59	404 (3380 - 171) 8	100	75

* in historic dataset, values below detection limits (<) are included at ½ detection limit for median calculations; historic dataset is from 1991 - 2016 unless otherwise indicated

[a] E. coli sampling started in 2008, [c] E coli objective is not final

[b] historic data calculated from 2003 – 2016 due to analytical method changes

**value shown is based on hardness of 300 mg/L, actual objective is a hardness-based equation ***un-ionized ammonia is calculated using temperature and pH, % detectable not applicable

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY
US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median (max - min) #samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max - min) #samples	2017 DATA % detectable	2017 %exceedance
Lead (total) [b]	**13	µg/L	0.28 (5.17 - 0.03) 109 [b]	100 [b]	0 [b]	0.32 (3.08-0.20) 8	100	0
Mercury	0.5 ug/g in fish flesh	µg/g	NS	NS	NS	NS	NS	
Molybdenum (total)	10	µg/L	2.22 (35.2 - 0.50) 190	99	3	2.79 (5.06 - 2.05) 8	100	0
Nickel (total)	**220	µg/L	3.13 (24.7 - <2.0) 205	93	0	4.34 (10.90 - 2.21) 8	100	0
Selenium (total)	5	µg/L	0.33 (1.81 - <0.1) 187	97.9	0	0.46 (0.66 - 0.36) 8	100	0
Zinc (total) [b]	30	µg/L	2.05 (12.90 - 0.30) 109 [b]	100 [b]	0 [b]	2.8 (13.5 - 1.0) 8	100	0
Miscellaneous								
Total Dissolved Solids	1,000	mg/L	825 (3821 - 149) 204	calculated	28	997 (1451 - 354) 8	calculated	50
Total Suspended Solids	the lesser of 10 mg/L or 10% over ambient	mg/L	12.6 (155 - <1) 205	99.5	61	22 (142 - 5) 8	100	38
pH (range)	8.5-6.5	standard units	8.4 (10.0 – 7.3) 215	100	40	8.4 (9.8 - 7.1) 8	100	38
Dissolved Oxygen (conc.)	>5.0	mg/L	8.44 (23.57 - 0.01) 214	100	19	8.0 (13.4 – 2.0) 8	100	25
Aesthetics		visual	NS			NS		
Oil and Grease		visual	NS			NS		

* in historic dataset, values below detection limits (<) are calculated at ½ detection limit; dataset is from 1991 - 2016 unless otherwise indicated
[b] historic data calculated from 2003 – 2016 due to detection limit changes (however, no exceedances in detectable values before 2003)
**value shown is based on hardness of 300 mg/L, actual objective is a hardness-based equation
NS: Not Sampled
calculated: parameter: calculated from other measured values, % detectable not applicable

2017 ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY
US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA** Median (max-min) # samples	HISTORIC DATA % detectable	HISTORIC DATA % exceedance	ANNUAL DATA 2017 Median (max-min) # samples	2017 DATA % detectable	2017 %exceedance
Organic Parameters								
Atrazine	2	µg/L	0.0160 (0.0464 - <0.0019) 71	66.2	0	0.0182 (0.0223 - 0.0130) 6	100	0
Bromoxynil	5	µg/L	<0.0081 (0.2020 - <0.0002) 97	28	0	0.0005 (0.0054 - <0.0002) 6	50	0
Carbaryl	90	µg/L	NS			NS		
a-Chlordane	0.0043	µg/L	<0.0001 (<0.0001 - <0.0001) 94	0	0	(< DL 0.00048) 6	0	0
g-Chlordane	0.0043	µg/L	<0.0001 (0.0011 - <0.0001) 94	1.1	0	(< DL 0.00041) 6	0	0
DDT	0.001	µg/L	<0.0004 (0.0027 - <0.0004) 94	1.1	1	(< DL 0.00040) 6	0	0
Dieldrin	0.0019	µg/L	<0.0003 (0.0003 - <0.0003) 94	1.1	0	(< DL 0.00133) 6	0	0
Dicamba	In development	µg/L	0.0097 (0.0451 - <0.0004) 97	48.5	-	0.0002 (0.0348 - < 0.0004) 6	33.3	-
Diclofop-methyl	In development	µg/L	<0.0074 (<0.0074-<0.0074) 95	0	-	(< DL 0.01160) 6	0	-
Heptachlor	0.0038	µg/L	<0.0001(<0.0001 -<0.0001) 89	0	0	NS	NS	
MCPA	0.20	µg/L	0.0150 (0.3150 - <0.0006) 97	53.6	4	0.0058 (0.0330 - 0.0021) 6	100	0
Parathion	0.04	µg/L	<0.0155 (<0.0155 - <0.0155) 33	0	0	NS	NS	
Phenols (total)	1.0	µg/L	NS			NS	NS	
Picloram	0.05	µg/L	0.0250 (0.1700 - <0.0007) 97	35.1	10	0.0051 (0.1320 - <0.0006) 6	66.7	33
Polychlorinated biphenyl (PCB total)	0.001	µg/L	<0.0002 (<0.0002-<0.0002) 43	0	0	NS	NS	
Triallate	0.57	µg/L	<0.0022 (0.0800 - <0.0022) 95	6.3	0	(< DL 0.00441) 6	0	0
Trifluralin	0.10	µg/L	<0.0026 (<0.0026 - <0.0026) 95	0	0	(< DL 0.00263) 6	0	0
2,4-D	4.0	µg/L	0.0445 (0.5870 - < 0.0005) 97	76.3	0	0.0431 (0.1770 - 0.0302) 6	100	0

** For Pesticides, historic data values below detection limits (<) are calculated at ½ detection limit; dataset is from 1991 - 2016 unless otherwise indicated. There are frequently multiple detection limits within the date range. The maximum for parameters with only one detection over the period of record (DDT, Dieldrin, Gamma Chlordane) is given as the value of the single detection, although detection limits higher than that value may have occurred. The median is given as the median of all detection limits.

NS: Not Sampled

APPENDIX F

Water Quality Monitoring Plan for Sherwood and Westhope

1. Sherwood Monitoring Plan

Season	No. of Site Visits	No. of Samples Per Year			
		Dissolved Oxygen	Major Ions	Nutrients	Trace Elements
1 (Mar-Jun)	2	2	2	2	2
2 (Jul-Oct)	4	4	4	4	4
3 (Nov-Feb)	1	1	1	1	1
TOTAL	7	7	7	7	7

2. Westhope Monitoring Plan

Season	No. of Site Visits	No. of Samples Per Year				
		Dissolved Oxygen	Major Ions	Nutrients	Trace Elements	Pesticides
1 (Mar-Jun)	3	3	3	3	3	3
2 (Jul-Oct)	3	3	3	3	3	3
3 (Nov-Feb)	2	2	2	2	2	
TOTAL	8	8	8	8	8	6